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Golder Associates

September 19, 2012

Project No.: 933-6154-005

Mr. Dion Novak
USEPA Region V (SR-6J)
77 West Jackson Boulevard
Chicago, IL 60604

RE: INTERIM REMEDIAL DESIGN REPORT
OPERABLE UNIT 2
NEASE CHEMICAL SITE, SALEM, OHIO

Dear Dion,

On behalf of RÜTGERS Organics Corporation (ROC), Golder Associates Inc. (Golder) is pleased to submit to the United States Environmental Protection Agency (USEPA) the Interim Remedial Design Report (IRDR) for Operable Unit 2 (OU-2) of the Former Nease Chemical Site located in Salem, Ohio. Copies have also been sent directly to the Ohio Environmental Protection Agency (Ohio EPA).

If you should have any questions during your review of this IRDR, please do not hesitate to contact Dr. Rainer Domalski at ROC (814/231-9200) or the undersigned (856/793-2005).

Very truly yours,

GOLDER ASSOCIATES INC.

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Enclosure

cc: Sheila Abraham, Ohio EPA
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Golder Associates: Operations in Africa, Asia, Australasia, Europe, North America and South America

REPORT

INTERIM REMEDIAL DESIGN REPORT

Operable Unit 2 (OU-2)
Former Nease Chemical Site
Salem, Ohio

Submitted To: RÜTGERS Organics Corporation
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State College, Pennsylvania 16801

Submitted By: Golder Associates Inc.
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Distribution:

3 Copies	U.S. Environmental Protection Agency
2 Copy	Ohio Environmental Protection Agency
1 Copy	RÜTGERS Organics Corporation
2 Copies	Golder Associates Inc.

September 2012

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AOC	Administrative Order on Consent
AW	Assessment Well
bgs	below ground surface
cis-1,2-DCE	cis-1,2-Dichloroethene
cm/sec	Centimeter per second
CSM	Conceptual Site Model
DNAPL	Dense non-aqueous phase liquid
DNAPL Tech Memo	Revised Southern Area DNAPL Technical Memorandum
DNAPL Tech Memo Addendum	Southern Area DNAPL Technical Memorandum Addendum
DO	Dissolved Oxygen
FRDR	Final Remedial Design Report
FS	Feasibility Study
Golder	Golder Associates Inc.
gpm	gallon per minute
IRDR	Interim Remedial Design Report
IW	Injection well
MIP/EC	Membrane interface probe/electrical conductivity
MKS	Middle Kittaning Sandstone
MNA	Monitored natural attenuation
MSL	Mean Sea Level
mZVI	Micron-scale zero-valent iron
nZVI	Nano-scale zero-valent iron
NAP	Natural Attenuation Parameters
Ohio EPA	Ohio Environmental Protection Agency
ORP	Oxidation-Reduction Potential
OU-2	Operable Unit Number Two
PCE	Tetrachloroethene
Pd	Palladium
PDI	Pre-Design Investigation
PID	Photoionization Detector
ppm	Parts per million
PRDR	OU-2 Preliminary Remedial Design Report
psi	Pounds per square inch
PVC	Polyvinyl chloride
QA/QC	Quality Assurance/Quality Control
RAOs	Remedial Action Objectives
RDWP	Remedial Design Work Plan
ROC	RÜTGERS Organics Corporation
ROD	Record of Decision
S/S/S	Stabilization, Solidification and Stripping
Site	Former Nease Chemical Site in Salem, Ohio
SPT	Standard Penetration Test
SSGA	Southern Shallow Groundwater Area
TCE	Trichloroethene
TOC	Total organic carbon
UIC	Underground Injection Control
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
ZVI	Zero-valent iron

1.0 INTRODUCTION

This Interim Remedial Design Report (IRDR) has been prepared by Golder Associates Inc. (Golder), on behalf of RÜTGERS Organics Corporation (ROC) and presents results from pre-design investigation (PDI) activities and a design update for key elements of the remedial design for the Operable Unit Number Two (OU-2) at the Former Nease Chemical Site in Salem, Ohio (Site). The information provided in this IRDR will be discussed further with the United States Environmental Protection Agency (USEPA) and the Ohio Environmental Protection Agency (Ohio EPA) at an upcoming meeting. This IRDR includes the following:

- **Ponds 1 and 2 In-Situ Stabilization, Solidification and Stripping (S/S/S)**: Section 2.0 provides the results of the additional geotechnical investigation and testing program completed for the S/S/S remedial design. This section discusses the completed geotechnical testing results including a proposed soils test mix and constituent compatibility, together with the strength and permeability results.
- **Eastern Area**: Section 3.0 provides the design for the Bedrock Groundwater ZVI remedy, including updates to the Preliminary Remedial Design Report (PRDR; Golder 2011), and the Eastern Shallow Groundwater Trench design configuration.
- **Southern Shallow Groundwater Area**: Section 4.0 provides results from the PDI Work Plan Addendum field investigation, treatability study results, and necessary next steps in the design.

2.0 PONDS 1 AND 2 IN-SITU STABILIZATION, SOLIDIFICATION AND STRIPPING

2.1 Overview

As part of the S/S/S testing program, test borings were completed to investigate the composition of the sludge and soil in the Former Pond 1 and 2 area, and to recover sludge and soil samples for use in laboratory testing. The geotechnical program was developed as part of PDI Work Plan Addenda, dated September 7, 2011 and April 27, 2012. The drilling and testing programs were completed in two phases. Phase 1 included three borings, and Phase 2 included ten borings. The boring locations are presented in Figure 2-1 and the field boring logs are presented in Appendix A. Phase 1 laboratory testing focused on classification of sludge and soil samples. Phase 2 testing focused on developing a mix design to stabilize the sludge and soils. Laboratory test results are presented in Appendix B.

The "Nease Chemical Site Salem, Ohio Treatability Evaluation In-Situ Stripping / Solidification / Stabilization" report (Kemron, 2008) and the "Stripping/Stabilization/Solidification (S/S/S) Treatability Study, Nease Chemical Site, Salem, Ohio" technical memorandum (Golder, 2008a) were reviewed prior to developing the mix design testing program, noting that the report targeted the "sludge" component of the soils for stabilization testing.

The key performance requirements for the S/S/S process entail achieving a minimum unconfined compressive strength of 15 pounds per square inch (psi) and maximum permeability of 1x10-6 centimeters per second (cm/sec). Laboratory testing was structured to develop a mix design that would meet these performance requirements. The air stripping portion of the process will be the subject of a method specification requiring minimum mixing times, and air injection with capture and treatment of the off-gases. Specifications will be included in the Final Remedial Design Report (FRDR).

The following sections outline the geotechnical investigation, and testing leading to the proposed S/S/S mix design and related conclusions.

2.2 Geotechnical Investigation

The geotechnical investigation of Former Ponds 1 and 2 was completed in two phases. The first phase, completed in November 2010, was originally planned to comprise of three test borings completed to bedrock using a hollow-stem auger rig (see Figure 2-1). However the work was suspended after encountering high volatile organic compound (VOC) readings in the breathing zone at the drill rig as the second boring (SB-10-G02) reached its termination depth. Subsequent to this work, a monitoring / recovery well RW-11-51/GW-11-02 was constructed within approximately 5 feet of SB-10-G02 in order to allow evaluation of suspected dense non-aqueous phase liquid (DNAPL) from the area. The

monitoring/recovery well was completed in January 2011 and has been incorporated into the DNAPL evaluation program.

The second phase of drilling, which consisted of ten test borings (SB-12-G06 through SB-12-G15) completed to bedrock, was completed in January 2012 (see Figure 2-1). The focus of this phase of drilling was to identify the extent of granular soil deposits and to collect samples of sludge, fine-grained soils, and coarse-grained soils for use in S/S/S mix design. A direct-push drilling method (Geoprobe®) was used in lieu of an auger drilling method based on the ability to recover continuous soil samples that would provide a complete visual profile of the soil column. Continuous samples were collected to allow identification of thinner granular soil layers that were suspected to be present and to generate sufficient volumes of soil for preparation of mix design samples.

The ten direct-push borings were completed as planned. Evidence of potential DNAPL (oily sheen and/or staining) was observed in six of the borings. During the first day of drilling, temporary well points were installed in consultation with the on-site Ohio EPA representative at three of the borings: SB-12-G10, SB-12-G13, and SB-12-G15. A 5-foot long screen was set in or below the impacted zone, and several attempts were made to recover DNAPL from these wells over a period of approximately 12 to 24 hours, however, no DNAPL was recovered. The temporary wells were subsequently abandoned. Logs of borings completed in 2010, 2011, and 2012 are presented in Appendix A.

In general, sludge and evidence of potential DNAPL impacts were encountered between elevations of approximately 1,176 feet and 1,182 feet with the exception of one boring (SB-12-G09) in which staining was encountered at elevation 1,171 feet, just above the soil-bedrock interface. Sludge thicknesses varied from about 6 inches to 4 feet. Granular soil layers ranged in thickness from about 3 inches to 6 feet, but were laterally discontinuous. Strong odors and visual impacts were typically observed in close vertical proximity to sludge. However some exceptions to this trend were observed such as in boring SB-12-G14 in which strong odors and visual impacts were reported but no sludge was observed. It should be noted that sludge and associated impacts were not encountered in four of the ten direct push borings (SB-12-G06, SB-12-G07, SB-12-G08 and SB-12-G12).

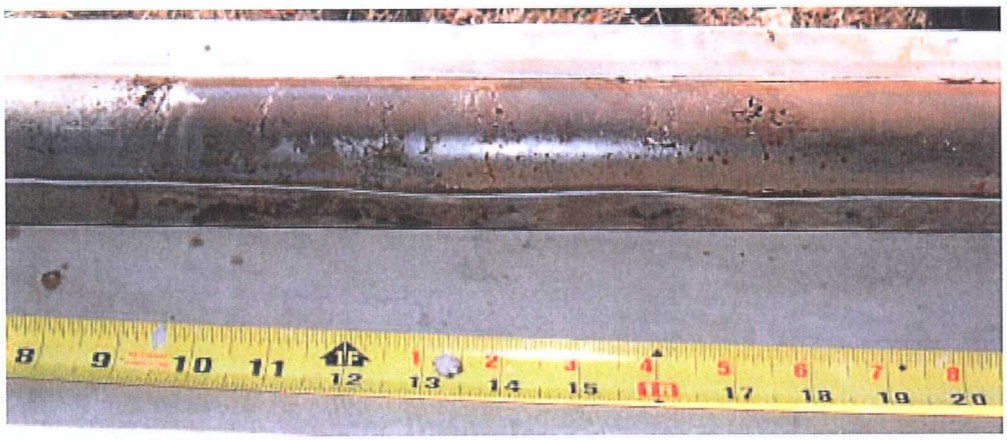
Coarser grained "sand" lenses were found to be comprised of "dirty" sand and gravel, i.e., sand and gravel intermixed with silt and clay.

Boring logs from previous test borings completed in 1990 (see Appendix A) show similar conditions with sludge encountered between elevations 1,174 feet and 1,185 feet and ranging in thickness from approximately 2 feet to 6.5 feet. Granular soil layers ranged in thickness from 3 inches to 5.5 feet. The 1990 logs also suggest the possibility of impacts in some deeper coarse-grained soil layers close to the

bedrock interface. The 1990 borings also indicate zones of perched water within the ponds as evidenced by wet/damp zones overlying dry zones.

Based on the findings of the geotechnical investigations, the lateral and vertical extents of DNAPL impacts do not appear to be appreciable. In some locations the vertical extents can be correlated to the presence of sludge (e.g., SB-12-G09). Some locations show the presence of a finer-grained soil below the sludge that appears to limit the vertical migration of impacts (e.g., SB-12-G13).

Photographs 1, 2, 3, and 4 are typical of impacts observed in the borings. Oily sheens, staining, and globules are visible on or in the samples.



Photograph 1 – SB-12-G07, 8 to 12 feet – oily impacts on clayey silt at 9-foot depth

Photograph 2 – SB-12-G09, 4 to 8 feet – staining in sludge at 6-foot depth

Photograph 3 – SB-12-G09, 4 to 8 feet – oily flecks in sludge

Photograph 4 – SB-10-G02, 20 to 22 feet – brown oil-like material in sandy soil at soil-bedrock interface

2.3 Geotechnical Testing and Results

Geotechnical testing was completed in two phases. Phase 1 testing focused on the classification of the soils and Phase 2 testing focused on developing a mix design for solidification/stabilization of the soils.

Select soil samples were identified from the November 2010 and January 2011 investigations with the objective of completing laboratory testing to confirm the field classification of the soils and to estimate the in-situ permeability of the sludge and soil. To that end, testing focused primarily on grain size distribution and plasticity indexes with moisture content and specific gravity analyses included for a number of samples. In addition, the permeability of both finer and coarser grained soils was evaluated via laboratory testing of undisturbed and remolded samples, respectively.

The results of the Phase 1 laboratory testing program are presented in Appendix B. The permeability of the sludge and fine-grained soil samples ranged from 4.1×10^{-5} to 3.9×10^{-8} cm/sec. These tests were completed on soil samples obtained from thin-walled, undisturbed (Shelby tube) samples. However, the remolded sample may not reflect in-situ solid density and moisture condtions.

2.3.1 S/S/S Mix Design

Phase 2 testing focused on establishing mix designs that would meet the strength and permeability requirements for the remediation of Former Ponds 1 and 2. The intent of the program was to prepare mix designs for three soil types, namely: sludge, fine-grained and coarse-grained soils. However, given the limited extent of coarse grained soils, testing proceeded using samples of sludge and fine-grained soil. Three composite, bulk samples were prepared in the field and submitted to the testing laboratory for physical property analysis, i.e., grain size, moisture content and plasticity indexes as well as pH. The samples were identified as SSS-01, SSS-02, and SSS-03-1 and SSS-03-2. Sample SSS-03 was split into two samples based on comments provided by the testing laboratory on the composition of the material. The grain size tests results classified samples SSS-01 and SSS-03-1 as a fine-grained (silty) material (sludge), with a pH of 6.2 and a moisture content ranging from 35.4% to 44.5%. Samples SSS-02 and SSS-03-2 were both identified as low plasticity clayey silt with a pH of 6.4 and a moisture content ranging from 12.9% to 17.3%. The soil was identified as ML-CL according to the Unified Soil Classification System (USCS).

The composite soil samples were prepared using representative Site soil samples. For the composite sludge samples SSS-01 and SSS-03-1, the sludge soils were developed from select intervals of soils borings SB-12-G09, SB-12-G11, SB-12-G12, SB-12-G13, and SB-12-G15 that showed typical odor and oily characteristics. The composite fine-grained soil samples (SSS-002 and SS-003-02) were developed from select intervals of soils borings SB-12-G09, G10, G12, G13, and G14, of which SB-12-G10 and SB-12-G14 showed typical oily characteristics. Oily characteristics of sheen, staining, and globules are illustrated in Photographs 1 through 4.

Having established the physical properties of both the sludge and the predominant soil, the testing program continued into the development of S/S/S mix designs using samples of both sludge and clayey silt. Because of the distinct differences between these materials, it is considered prudent to establish mix

designs using each material and then, based on test results, select one mix design that can effectively treat both materials. The exclusion of a granular soil sample from mix design testing is not a significant concern as 2 feet to 3 feet of vertical mixing is anticipated to occur within each soil column during field implementation which will blend these soils, which have limited extent, with the sludge and fine-grained soils.

For mix design preparation, the sludge and clayey silt samples were identified as SSS-01 and SSS-02, respectively. Based on the results of prior testing and experience, the decision was made to prepare mixes using a combination of cement and bentonite. Cement will serve to increase strength and bond soil particles together while bentonite will reduce permeability and aid in the delivery of the reagents during construction. A 5% bentonite slurry was prepared to which various ratios of cement ranging from 2% to 12% were added. The batches of slurry were then mixed into the sludge and clayey silt using a high speed shear mixer. The slurry was prepared using treated water collected from the on-site wastewater treatment plant in order to evaluate the impacts of beneficially reusing this water. Use of the treated water could potentially eliminate the use of potable water; however, the logistics of providing the volume of water required over the timeframe needed has yet to be evaluated. Eight 2-inch by 4-inch polyethylene test cylinders of each mix were prepared, capped and placed in a cooler to cure. A total of 48 cylinders were prepared for future testing.

At 7, 10, 14, and 28 days cylinders were removed from the cooler and subjected to strength testing. As expected, strength increased both with increasing cement content and with increasing curing time. The strength test results are summarized in Table 2-1.

Table 2-1

Summary of Compressive Strength Test Results

Sample ID	Material	Cement Content (%)	Unconfined Compressive Strength (ASTM D1633) (psi)			
			7-day	10-day	14-day	28-day
SSS-1-1-3	Sludge	3	11.1	12.7	14.8	16.2
SSS-1-2-6	***Sludge***	***6***	***46.2***	***64.9***	***76.2***	***86.6***
SSS-1-3-12	Sludge	12	105.0	188.1	239.9	268.7
SSS-2-1-2	Clayey Silt	2	13.1	13.4	17.0	22.0
SSS-2-2-4	***Clayey Silt***	***4***	***22.0***	***27.1***	***31.8***	***40.1***
SSS-2-3-8	Clayey Silt	8	29.3	37.2	40.5	56.3

Bold italic indicates samples selected for permeability testing.

As shown in Table 2-1, the targeted 28-day strength of 15 psi was achieved by all six samples. Four of the six samples achieved the targeted strength after 7 days. The sludge sample with 3% cement did not achieve the targeted strength until 28 days, although at 14 days the strength was measured at 14.8 psi which was only slightly below the targeted 15 psi strength. The clayey silt sample with 2% cement did not achieve the targeted strength until 14 days.

Based on the results of the strength tests, two mixes were identified for permeability testing: the sludge mix with 6% cement (SSS-1-2-6) and the clayey silt mix with 4% cement (SSS-2-2-4). Samples of these mixes were subjected to permeability testing in accordance with ASTM D5084 for a period of 15 days using laboratory tap water as the permeant. The baseline permeability values were determined to be $5.3x10^{-7}$ cm/sec and $2.9x10^{-7}$ cm/sec, respectively. Upon completion of the baseline permeability tests, compatibility testing (long-term permeability testing) in accordance with ASTM D7100, commenced. The long-term testing was completed using Site groundwater obtained from monitoring well TW06-14 as the permeant in order to replicate field conditions to the extent practicable. The permeability of the sludge sample (SS-1-2-6) at the end of the test period was estimated to be $2.8x10^{-7}$ cm/sec. The test ran for a period of 52 days. The permeability of the clayey silt sample (SS-2-2-4) at the end of the test period was estimated to be $1.0x10^{-7}$ cm/sec. The test ran for a period of 85 days. Permeability test results are presented in Appendix B and summarized in Table 2-2. There was no evidence during testing to suggest that the groundwater adversely affected the mixes nor was there any evidence of clogging or biological growth within the samples. It should be noted that the permeability tests were performed under a hydraulic gradient of 25, which is much higher than is expected in the field, so the results are likely to be conservative.

Table 2-2

Summary of Permeability Test Results

Sample ID	Material	Baseline Permeability with tap water (cm/sec)	Long-term Permeability with untreated groundwater (cm/sec)
SS-1-2-6	Sludge	$5.3x10^{-7}$	$2.8x10^{-7}$
SS-2-2-4	Clayey Silt	$2.9x10^{-7}$	$1.0x10^{-7}$

The target field permeability for the stabilized sludge and clayey silt is $1x10^{-6}$ cm/sec or lower. The test results indicate the selected mix designs with 4% and 6% cement and 5% bentonite should be able to achieve the targeted value with a conservative safety factor to account for scale up from laboratory conditions.

The pH of the sludge prior to mixing with cement and bentonite was 6.23. The initial pH of the permeant water (groundwater) at the start of the long-term permeability test on the sludge sample (SSS-1-2-6) was 7.9. The pH of the permeant water at the end of the test was 8.5. The pH of the clayey silt prior to mixing with cement and bentonite was 6.42. The initial pH of the permeant water at the start of the long-term permeability test on the clayey silt sample (SSS-2-2-4) was 7.16. The pH of the permeant water at the end of the test was 11.18. While an increase in pH was anticipated due to the addition of cement and

bentonite, the apparent increment in this case is larger than expected, so confirmatory pH testing will be completed.

2.4 Conclusions

Based on the findings of the field investigation program, the S/S/S program will extend from the ground surface to the soil-bedrock interface to ensure treatment of all sludge and impacted soil zones. During the implementation of the stabilization program vertical mixing will occur over a length of 2 feet to 3 feet within each soil column. This vertical mixing will result in the homogenization of the various soil layers into a more uniform, stabilized mass. The use of representative sludge and soil samples in combination with Site groundwater for testing provides a high level of confidence that the Site contaminants will not negatively impact the strength and permeability performance of the remedy.

Based on the field and laboratory test data, the Contractor will conduct field validation of the mix design via pilot scale testing to confirm achievement of the strength and permeability requirements. In addition, the specifications will require the capture of off-gases resulting from the mixing/stripping process. The results of the laboratory mix design program indicate that a mix using a 5% bentonite slurry with between 4% and 6% cement should provide a stabilized soil matrix will satisfy the design requirements. The Contractor may opt to adjust the mix design based on the results of additional testing and construction experience. Final acceptance of the Contractor's mix design will be based on the results of tests completed on samples collected during the field pilot-scale program.

What is the permeability reduction design STD to be achieved with this mixture ratio?

3.0 EASTERN AREA

3.1 Overview

Treatment of VOC-impacted, bedrock groundwater and the remedy for the eastern, impacted shallow groundwater are presented in this section. As described in the 2005 Record of Decision (ROD), bedrock groundwater will be treated by injection of zero-valent iron (ZVI) in the core of the plume. Two injection wells will be located in the Former Pond 1 area, an array of injection and performance assessment wells will be located on the eastern side of the rail-line, and three additional injection wells will be located downgradient of the main line of injection wells. The eastern shallow groundwater will be collected in a shallow collection trench and treated either in situ or ex situ. S/S/S treatment of Former Ponds 1 and 2, as well as construction of the low permeability cover system will support the eastern area remedy by reducing overall infiltration and the mobility of VOCs from the area of Former Ponds 1 and 2. These remedies have been developed based on PDI activities and current industry design standards.

3.2 Bedrock Groundwater ZVI

Deep bedrock groundwater will be treated by injection of ZVI in the core of the plume, with the remedial action objective of protecting Middle Kittaning Sandstone (MKS) groundwater receptors. Monitored natural attenuation (MNA) will address peripheral, lower concentration portions of the plume, downgradient of the treatment zone. If determined to be necessary, the ZVI treatment will be augmented with accelerated biological treatment. The treatment area, injection system, and performance monitoring network are presented in the following sections and are based on data collected during pilot tests conducted in 2006 and 2009[1].

nZVI

3.2.1 Overview and Design Basis

The bedrock groundwater will be treated by injection of ZVI within the core of the plume. A plan view of the bedrock plume, based on analytical results collected in October-November 2010, is shown in Figure 3-1. Results from laboratory bench tests (Golder, 2006) and pilot tests conducted in 2006 (Golder, 2008) and 2009 (Golder, 2010) as part of the PDI were used as the basis for the design of the treatment system. Additional laboratory column bench tests were conducted in 2011 to determine design parameters for ZVI treatment of the southern shallow groundwater, which is impacted with similar contaminants to the bedrock aquifer. These bench tests indicated that micron-scale ZVI (mZVI) can be as effective as nano-scale ZVI (nZVI) in treating primary site contaminants. As a result, a mixture of nZVI/mZVI is proposed for injection. Results from the pilot and bench scale tests indicated:

nZVI

nZVI pilot

- The hydraulic radius of influence and diffuse reactive zone is greater than 32 feet, indicating that well spacing of 70 feet is appropriate

[1]The performance monitoring network are the wells to be used to monitor the performance of the ZVI injections. The long-term compliance monitoring well network will be described in the FRDR.

- Reaction longevity indicates that injection on a quarterly basis is an appropriate starting rate
- Introduction of ZVI via pressure injection with the use of a dispersant, such as soy powder is recommended
- Use of ZVI with palladium (Pd) to serve as a catalyst proved effective to treat bedrock groundwater impacts
- Variable injection rates achieved between NZVI-3 (in 2006) and NZVI-5 (in 2009) demonstrate the potential heterogeneity of the transmissivity of the aquifer and that the full-scale design should assume that hydrofracturing may be necessary at all injection points

The following sections present the injection well (IW) and performance assessment well (AW) layout, well construction details, hydraulic fracturing procedures, sampling program and protocol, injection slurry composition/ZVI dosage, injection procedures, and performance monitoring. Implementation of the remedy will be conducted in phases (see Section 3.2.4) to accommodate other remedial action activities (see discussion in following section) and to facilitate using data collected from initial injection well(s) to refine, if necessary, the well spacing in the source area.

3.2.2 *Injection Well Layout*

The layout of the injection wells and performance assessment wells are illustrated in Figure 3-1[2] and have been modified from the PRDR (Golder, 2011) to accommodate implementation of other remedies. Injection wells IW-3 to IW-9 are now located along the eastern side of the Norfolk-Southern railway corridor to permit the initiation of ZVI injections prior to S/S/S activities in Former Ponds 1 and 2, and to prevent these injection wells from interfering with or being damaged by S/S/S activities. As the S/S/S activities have the potential to agitate contaminants in the saturated zone, initiating ZVI injections prior to these activities will provide treatment for groundwater that may be impacted by these activities. This will also permit performance assessment wells AW-1 to AW-6 to be approximately 50 feet downgradient of the injection wells. Source area injection wells IW-1 and IW-2 will be installed within the S/S/S area, following completion of S/S/S activities.

A total of twelve injection wells (IW-1 through IW-12) will be placed in the core of the plume, as described in Table 3-1[3]. These wells will include:

- Two source area wells (IW-1 and IW-2)
- Seven wells across the core of the plume immediately downgradient of the source area (IW-3 through IW-9)
- Three wells (NZVI-5/IW-10, IW-11, and IW-12) in the core of the plume, further downgradient of the main line of injection wells (IW-3 through IW-9)

[2] Locations of these monitoring wells are approximate and may be moved in response to right-of-way, utility, drainage concerns, field conditions, or due to information gathered during implementation.
[3] Well screen intervals are approximate, based on existing borehole records, and may be adjusted during construction.

The two source area injection wells will be installed within Former Ponds 1 and 2 and will treat groundwater beneath the S/S/S treatment area. These wells will be completed following completion of the S/S/S activities, prior to construction of the low permeability cover system.

The seven immediately downgradient injection wells are spaced at 70-foot intervals across the core of the plume, along the eastern side of the Norfolk-Southern railway corridor and will treat groundwater flowing downgradient from the area of Former Ponds 1 and 2 within the 100,000 and 10,000 microgram per liter (µg/L) total VOC iso-concentration contours (2010 data, Figure 3-1). The three injection wells located further downgradient (approximately 120 and 300 feet), within the core of the plume, will treat groundwater east of the railway and will include existing well NZVI-5/IW-10 and two new injection wells (IW-11 and IW-12) located just west of the 1453 Allen Road building.

It is anticipated that the injections in the source area (IW-1 and IW-2) and immediately east of the Norfolk-Southern railway will be required longer than the downgradient injections (IW-10, IW-11, and IW-12). When groundwater treated by the source area injection wells reaches the downgradient injection wells, further treatment is not expected to be required (Section 3.2.6.3).

Also shown on Figure 3-1 and described in Table 3-1 are nine performance assessment wells (AW-1 through AW-7 and temporary performance assessment wells, AW-A and AW-B), which will be used to monitor the treatment progress:

- Two temporary performance assessment wells (AW-A and AW-B), downgradient of source area injection wells and in-line with the seven injection wells across the core of the plume immediately downgradient of the source area to be used to refine the well spacing along the eastern side of the railway corridor
- Six performance assessment wells (AW-1 through AW-6), downgradient of the seven injection wells across the core of the plume, along the eastern side of the Norfolk-Southern railway corridor
- One performance assessment well (AW-7), downgradient of the two furthest downgradient injection wells (IW-11 and IW-12)

The performance assessment wells will be constructed so as to be capable of being retrofitted to serve as injection wells, if it is determined to be necessary at a later date[4]. As discussed in greater detail in Section 3.2.4, injection well IW-3 and temporary performance assessment wells AW-A and AW-B will be installed first, and hydrofracturing will be attempted in IW-3 while monitoring AW-A and AW-B. The results from this will be used to confirm the appropriate spacing of injection wells.

[4] Should any performance assessment wells be adapted to serve as injection wells, the need for additional performance assessment wells will be evaluated.

A mixture of 50% nZVI and 50% mZVI will be used for the initial injection event in all injection wells. Palladium acetate will be added to the slurry mixture at a concentration of 0.05% wt/wt kg and soy protein powder will be added as a dispersant. Further changes to the nZVI/mZVI ratio will be made based on the observed treatment effectiveness.

3.2.3 Well Construction

Slow injection rates achieved in NZVI-3 in the 2006 pilot test suggested that the final remedy should incorporate features (such as hydrofracturing) designed to increase the injection flow rate, although injection rates achieved in the 2009 pilot test indicated that hydrofracturing was not required. Therefore, injection wells are of open-hole design (rather than using a sand pack which may cause clogging) and will allow for over-drilling of the open hole portion so that if clogging of the fractures on the inner surface of the borehole is suspected, it may be removed by over-drilling. This design will also support hydrofracturing to enhance injection of treatment materials. Hydrofracturing will be initiated in all injection wells, following construction. Should the interval be sufficiently transmissive, backpressures above lithostatic pressure will not be generated and hydrofracturing will be deemed unnecessary.

Injection well construction details are as follows:

- Each well will be cased to minimize potential cross-contamination with the shallow groundwater; casing will be set into bedrock
- Each well is anticipated to be constructed with 8-inch diameter PVC casing installed approximately 5 feet into the Middle Kittanning Sandstone (MKS) (well depths are anticipated to be on the order of 35-55 feet bgs) using either hollow stem auger and air-rotary methods or sonic drilling methods, while the next phase of the boring will be completed by drilling within the 8-inch casing, using air-rotary methods or sonic drilling methods
- A nominal 6-inch diameter borehole will be advanced to a final depth, approximately 15-30 feet below the top of the MKS and anticipated to be on the order of 45 feet bgs[5], using air-rotary or sonic drilling

A conceptual cross-section of the injection system is illustrated in Figure 3-2, with representative injections wells from each array east of the rail-line represented. Typical injection well construction details are included in Figure 3-3 and installation procedures will be provided in the FRDR. Each injection well will be completed as flush-mounted[6] and will be constructed with a protective outer casing and minimum 24-inch diameter and 2-foot deep vault (or equivalent) to allow for spill protection of the injection material and may be constructed of a polyethylene material, compatible with the geomembrane. Wells will be constructed in coordination with cap construction and final grade. Performance assessment wells will be constructed in a similar manner so that they could be converted to injection points, if necessary. Injection

[5] Final well depths will be based on the depth to bedrock and the target treatment/monitoring depth for each well.
[6] Well completions may be modified due to field conditions.

well heads will be fitted with pressure fittings to easily attach to the injection system (Section 3.2.6). Following installation, each well will be developed using a pump or other purging method in accordance with the Ohio EPA "Technical Guidance for Hydrogeologic Investigations and Ground Water Monitoring, Chapter 8, Ohio EPA, February 2009". Underground Injection Control (UIC) permits or permit equivalencies for Class V injection wells may be required, and will be discussed in more detail in the FRDR.

3.2.4 Construction Sequence

The pilot tests conducted in 2006 and 2009 demonstrated:

- that ZVI can effectively treat bedrock contaminants
- that a radius of influence of greater than 32 feet can be achieved
- that hydrofracturing may be required at some locations to achieve this radius of influence
- that the hydraulic properties of the bedrock can be heterogeneous

Hydraulic fracturing of bedrock will be initiated in all injection wells prior to injections to optimize delivery of ZVI to the treatment areas; should the well be so transmissive as to be unable to initiate a fracture cycle, hydrofracturing procedures will not be needed (Section 3.2.5). Construction of injection wells will be conducted in a phased approach to accommodate other implementation activities, field conditions, and to permit observations regarding the performance and hydrofracturing attempts in the initial wells to be constructed to adjust the details (e.g.; spacing) of subsequently installed injection wells.

Construction of the ZVI injection wells and performance assessment wells will be conducted generally in the following phases:

- Installation of IW-3, AW-A, and AW-B
- Installation of IW-4 through IW-12 and AW-1 through AW-4, AW-7
- Installation of AW-5 and AW-6
- Installation of IW-1 and IW-2 (after completion of S/S/S activities)

To confirm the radius of influence in the bedrock on the eastern side of the Norfolk-Southern railway corridor, IW-3, AW-A and AW-B will be installed first. Hydrofracturing will be attempted in IW-3 and a conservative tracer (such as sodium bromide or similar) will be injected into IW-3 while monitoring AW-A and IW-B with pressure transducers and an ion-selective electrode (or appropriate alternative), which will be described in detail in the FRDR. If any adjustments to the well spacing, construction details, hydrofracturing protocol, or injection protocol are indicated by the results of this monitoring, they will be made at this time and the majority of the remaining injection wells and performance assessment wells (IW-4 through IW-12, and AW-1 through AW-4 and AW-7) will be installed at this time. Performance assessment wells AW-5 and AW-6 will be installed following installation of the soil barrier cover in Former

Pond 3, when a drill rig will be able to access those locations. Injection wells IW-1 and IW-2 will be installed following S/S/S activities, as noted previously. ZVI injections will begin, following baseline sampling, in IW-3 through IW-12 ahead of the installation of other injection and performance assessment wells.

3.2.5 Hydrofracturing

Prior to ZVI slurry injection, the open borehole wells will be hydraulically fractured, as necessary, according to procedures that will be detailed in the FRDR. Hydrofracturing will be attempted in areas of low permeability to maximize the area of influence of each injection point. In areas of high permeability, the back pressure developed by the hydrofracturing pump will be less than lithostatic pressure and hydrofracturing will not be needed. The proposed fracture interval will be in the bottom 5 to 7 feet of the open borehole (the packer seal will occupy the remaining 3 feet to bottom of casing) and will based on the transmissivity and the ability to initiate a fracture cycle.

The packer systems used by Golder are generally manufactured by Baski and are designed to provide seals up to 3,600 psi in boreholes ranging from 4-inch diameter to 8-inch diameter. To provide flow to the packer when it is deployed down-hole, water is channeled through 2-inch black steel pipe, or equivalent, with couplings sealed using Teflon sealant. Packer inflation is achieved using 3/8-inch diameter hydraulic hose run outside the 2-inch diameter pipe.

The pumping system consists of a gas-engine, pressure washer pump with a 3,500 psi pressure maximum and a 4 gallon per minute (gpm) flow capacity. Flow is controlled through a manifold that allows for packer inflation and test zone injection from the same pumping source. The packer pressure is monitored continuously along with the pressure within the packed interval.

Testing begins by setting the packer at the desired fracture interval. Once the packer is set (it is anticipated that the packer pressure against the borehole wall will likely be approximately 500 psi) water is allowed to flow through the system with the test-zone/fracture interval pressure measurement line open, to flush air from the hydraulic hose and the 2-inch pipe. Hydraulic fracturing tests consist of one (1) pressurization cycle. The pressurization cycle begins by injecting water in the closed fracturing interval at a low flow rate (~0.5 gpm). The water injection flow rate is then slowly increased. Since the fracturing interval is closed, the pressure is building up in the closed system until pressure greater than the lithostatic pressure[7] is reached, then followed by a sudden drop in pressure. This is the result of a fracture initiation. It is Golder's experience that under similar conditions (shallow sandstone bedrock) the fracture initiation pressure will likely be less than 300 psi[8]. This fracture initiation pressure is likely the

[7] The lithostatic pressure is typically 1 psi per foot (e.g., for a 60-foot deep well, the lithostatic pressure is approximately 60 psi).
[8] Note that, as observed in the 2009 nZVI pilot test, if the transmissivity is sufficiently high, hydraulic fracturing may not be necessary in all locations.

pressure necessary to open and propagate existing fractures (e.g., bedding plane partings) rather than the pressure to generate a primary fracture in the MKS.

Once the water injection is stopped the newly formed fracture closes under the lithostatic pressure. A second fracturing cycle is then used to establish the fracture re-opening pressure (jacking pressure). The hydraulic jacking test consists of several constant pressure steps that are designed to define the fracture re-opening or jacking pressure. Golder anticipates this type of response and expects the re-opening pressure for this shallow bedrock system to be on the order of 50 psi to 100 psi. As indicated above, the re-opening pressure is related to the lithostatic pressure (the pressure of the rock formation above) and any pressure loss from inefficiencies. When the water injection is stopped the re-opened fracture will close under lithostatic pressure. The fracture re-opening pressure is the minimum pressure needed to inject the ZVI slurry.

The hydraulic fracturing will be performed in general accordance with the testing methodology that will be outlined in the FRDR, which is consistent with the Standard Test Method for Determining In-Situ Stresses by Hydraulic Fracturing Method, ASTM Designation D 4645. In general, the procedure includes:

- Reviewing geologic logs and/or observing existing rock core to select the best suited intervals free of geologic discontinuities
- Installing appropriately sized packers into a smooth-sided borehole advanced into competent (e.g., non-fractured) bedrock
- Setting the packers at the desired test interval and inflating with a positive pressure pump
- Incrementally pressurizing the desired test interval using the positive pressure pump recording pressure data
- Observing pressure data for a sharp decrease in pressure indicating a fracture has occurred
- Performing "hydro-jacking" by re-pressurizing the test interval following the initial fracturing to "develop" the fracture, thereby increasing in-situ hydraulic conductivity and record the fracture re-opening pressure subsequent to hydro-jacking cycles

3.2.6 Injection Program

3.2.6.1 Injection Protocol

The overall objective of the remedy for the bedrock groundwater is to provide groundwater receptor protection. There are currently no receptors for the impacted bedrock groundwater, and groundwater quality will be monitored as will described in the FRDR. A baseline sampling event will be conducted following well installation[9], but prior to any injection activities, to obtain a pre-treatment ("baseline") status of the bedrock groundwater quality, as well as to provide additional basis for refining injection slurry

[9] Excepting those injection wells to be installed following completion of other remedial activities.

calculations, if necessary. This baseline sampling event will include sampling of both injection and assessment wells for VOCs, field parameters, and select natural attenuation parameters (NAPs)[10].

The primary design challenge associated with injections of ZVI slurry is achieving adequate contact time between the iron particles and contaminants. The use of soy powder as a dispersant is one method that was used in the pilot tests to increase the effectiveness of iron delivery and, as previously discussed, hydraulic fracturing of the geologic formation will be conducted in low permeability zones so that iron particles can be "pushed" into the formation where groundwater is flowing.

The injection into each well will be conducted as a batch process as will be described in the FRDR and will be conducted according to an Underground Injection Control (UIC) Permit, also discussed in greater detail in the FRDR. The injection set up will be installed temporarily about each injection well and will be relocated to each subsequent well after completion of injection in one well. Injections will be conducted from the outer edges of the treatment area inward. The operation of the system will be conducted by Golder staff. The pumps, pipes and tanks will be decontaminated and stored on-site after completion of each round of injection. Unused chemicals will be stored in a secure area on property. Usable equipment will be reused during subsequent rounds of injection.

Following baseline sampling and the first injections, progress monitoring samples will be collected from the performance assessment wells, for analysis for VOCs, select NAPs, and field parameters immediately prior to each quarterly injection event. It is currently anticipated that injections and progress monitoring will be conducted on a quarterly basis for the first one to two years, as discussed in Section 3.2.7. The injection volumes and frequency of injection and monitoring events will be evaluated as the program progresses, and may be adjusted as required to improve performance. The method by which the effectiveness of the injection program will be monitored is described in Section 3.2.6.3 and includes the following:

- Evidence for VOC degradation (decreasing concentrations of parent compounds [e.g., tetrachloroethene (PCE)] and increasing concentrations of daughter compounds [e.g., cis-dichloroethene (cis-DCE)]
  - The main anticipated pathway is: PCE → trichloroethene (TCE) → cis-1,2-DCE → vinyl chloride → ethene → ethane
- Decreasing VOC total molar concentrations in performance assessment wells
- Increasing concentrations of ultimate daughter products (e.g., ethene)
- Changes in NAPs that suggest active biodegradation

[10] NAPs are anticipated to include: total organic carbon (TOC), nitrate, sulfate, sulfide, methane, ethane, ethene and total iron. Standard field parameters include: turbidity, Oxidation Reduction Potential (ORP), Dissolved Oxygen (DO), pH, specific conductivity and temperature.

Should ZVI injections be determined to create a significantly favorable environment for biodegradation of Site compounds, then accelerated biological treatment may be implemented (Section 3.2.8), which may include nutrient injections (with or without bioaugmentation). The need to augment the ZVI treatment through accelerated biological treatment is anticipated to be evaluated some time following the first year of ZVI injections. This evaluation will be based on whether the design performance standards and Remedial Action Objectives (RAOs) could be met by ZVI alone, or with ZVI treatment supplemented by nutrient injections (with or without bioaugmentation) that would lead to enhancing the environment favorable to dechlorinating bacteria[11].

3.2.6.2 Injection Slurry Composition

In the bench tests conducted in 2006, and nZVI pilot tests conducted in 2006 and 2009, it was demonstrated that an nZVI slurry composed of water, ground ZVI powder, low levels of a palladium catalyst (palladium acetate), and an organic dispersant (soy protein powder) is effective at treating chlorinated compounds. Additional bench scale tests conducted for the southern area plume (see Appendix C) have demonstrated that mZVI can be as effective as nZVI. Moreover, the nZVI particles have a high tendency to agglomerate in groups of particles with an overall micron-scale size. As a result, the injectability of mZVI is similar to the injectability of nZVI. The proposed injection approach to be used for the initial injection event is to inject a slurry mixture that is 50 percent mZVI and 50 percent nZVI and an added palladium quantity of 0.05% wt/wt kg ZVI, and soy protein powder will be added as a dispersant.

It is anticipated that injection solutions similar to those used in the pilot tests and preliminary estimated ZVI masses have been calculated and are presented in Table 3-2. Actual slurry compositions and nZVI/mZVI ratio will be adjusted following observations made during well installation, hydrofracturing, baseline sampling, and effectiveness sampling. Adjustments to the mixture of nZVI/mZVI will be made by comparing injection results to the previous pilot test injection effectiveness. Similar effectiveness indicates that the nZVI/mZVI mixing ratio is as effective as nZVI alone. In addition, the treatment longevity will also be evaluated since it is expected that the larger scale ZVI (i.e., mZVI) will be more persistent and provide electrons for the dechlorinating reaction for a longer time than the smaller size nZVI.

3.2.6.3 Performance Assessment

The overall objective of the remedy for the bedrock groundwater is to provide groundwater receptor protection. There are currently no receptors for the impacted bedrock groundwater, and overall groundwater quality will be monitored as will be described in the FRDR. As summarized above, following initiation of the injection program, performance assessment samples will be collected from the

[11] The synergy between ZVI treatments and bioremediation has been documented and published (Golder, 2009).

performance assessment wells, to be analyzed for VOCs, select NAPs, and field parameters, on a quarterly basis immediately prior to each injection event. Performance of the ZVI injection activities will be evaluated by looking for evidence of VOC degradation, changes in NAPs that suggest active biodegradation, and changes in field parameters that support an environment favorable to dechlorinating bacteria.

Lines of evidence that are indicative of VOC degradation include declining overall concentrations of parent compounds; initial increases followed by decreases in overall concentrations of daughter compounds; decreasing total molar concentrations of VOCs; and increases in ultimate daughter products, such as ethene.

The introduction of ZVI produces a reducing environment, with low dissolved oxygen, and may support the growth of native microbes such that contaminants are destroyed to harmless by-products through anaerobic biodegradation. The use of an organic carbon dispersant (soy powder), will also provide an additional carbon source for the native microbes. NAPs and field parameters that will be examined to look for evidence for biodegradation include:

- Dissolved Oxygen
- Oxidation-Reduction Potential (ORP)
- Total organic carbon (TOC)
- Nitrate
- Sulfate/sulfide
- Methane, ethane, ethane

Declining concentrations of VOCs not known to degrade significantly through reductive dechlorination may also indicate active biodegradation.

As indicated earlier, reaction longevity in the pilot tests indicated that an injection frequency of once a quarter is appropriate. However, should results from the progress monitoring samples indicate that the reaction longevity is greater, the time between injection events may be lengthened[12]. The results from the progress monitoring samples may also indicate that reaction longevity may vary in different parts of the plume. Treatment may be reduced (less iron injected/injected less frequently) in some areas (such as in wells on the edges of the plume core) or increased in others (immediately downgradient of the source area). As treated groundwater moves downgradient, treatment in downgradient injection wells may be eliminated, with USEPA agreement, if progress monitoring samples indicate that no further treatment is

[12] Conversely, should the progress monitoring indicate that reaction longevity is shorter, the time between injection events may be shortened.

warranted. Removal of wells from the injection program will be preceded by decreasing the injection frequency (i.e.; from quarterly to semi-annually) before stopping completely.

3.2.6.4 Converting Performance Assessment Wells to Injection Wells

As stated earlier, performance assessment wells will be constructed, as the injection wells, with an open-borehole design, so that they might easily be converted to injection wells. The decision to convert performance assessment wells into injection wells will be made if performance assessment results indicate that significant treatment improvement would be gained by converting one or more performance assessment wells to injection wells. This assessment will likely be made following the first year or two of injections. Should performance assessment wells be converted to injection wells, the need for additional performance assessment wells will be evaluated at that time.

details of conversion how/when?

3.2.7 Performance Standards

As set forth in the OU-2 Record of Decision (ROD), the final Performance Standards applicable to the contaminated MKS groundwater plume is to protect MKS groundwater receptors. ZVI injections will be continued for so long as continued treatment has a significant impact on the reduction of VOCs in the groundwater. Performance assessment results will be used to monitor the continued effectiveness of treatment, and to determine if and when modifications to the treatment program is warranted, and to determine when it is no longer efficient and sustainable to continue treatment. At an appropriate time, a recommendation to stop treatment will be made to USEPA, together with an on-going monitoring program.

stds per ROD from ROD what are they

N2VI vs ZVI overall approach

3.2.8 Accelerated Biological Treatment Evaluation

Treatment of groundwater impacted with chlorinated VOCs with ZVI creates an anaerobic environment and has been demonstrated to have a synergistic effect with biodegradation by naturally occurring microbes (Golder 2009). Should ZVI injections create an appropriate environment for this synergistic effect to be observed, then accelerated biological treatment may be implemented to support the additional biodegradation of Site compounds. If needed, biological treatment will be supported through nutrient injections such as injection of a carbon source (and may or may not include bioaugmentation). The need to augment the ZVI treatment through accelerated biological treatment will be based on whether the design performance standards and RAOs might not be met by ZVI alone, or with ZVI treatment enhancing the environment favorable to dechlorinating bacteria. Accelerated biological treatment may continue beyond the ZVI injections. Performance assessment results (VOCs and NAPs) as they change through time, will be used to evaluate whether or not the treatments will be sufficient to provide protection of receptors to impacted bedrock groundwater. The need to augment the ZVI treatment through accelerated biological treatment is anticipated to be evaluated following the first year of ZVI injections, and will continue to be evaluated thereafter.

how will this be determined

3.3 Eastern Shallow Collection Trench

As noted in our past meetings with the Agencies and the Response to Agency Comments to the PRDR (Golder, 2012a), the Eastern Groundwater Collection Trench configuration has been modified. The OU-2 PRDR drawings have been updated and are included in this report. Additionally, these drawings will form the basis of the FRDR. Modifications are noted as follows:

- The groundwater trench and the surface stormwater flow channel have been incorporated into one system and are both heading northerly and outlet to Feeder Creek.
- The trench/channel systems have been combined and will incorporate a 2-foot deep channel, 18 inches of soil or riprap cover, and a 2 foot deep trench for a total of a minimum depth of 5.5 feet. This will be incorporated with an engineered grade into the existing surface contours in the FRDR design.
- As presented in the OU-2 PRDR, the Eastern Groundwater Collection Trench is below the geomembrane cover and at the low point in the cover system. The groundwater collection trench will intercept and collect the shallow groundwater now feeding the seep area while being isolated from surface water flows. It is isolated by the geomembrane below the cover with any surface water flow going to the Feeder Creek.
- The trench has collection trench riser pipes that have been sized for future access for an in-situ treatment system or an active pumping system, if necessary. The anticipated maximum flow has been calculated at approximately 0.4 gpm (See PRDR Appendix E-4) which is minimal. The trench capacity will be specified in the FRDR and is anticipated to be a poorly graded aggregate with a capacity to handle the final design flows, if any, as well as any anticipated construction staging flows that may be encountered.

Revised PRDR Drawing 2, "Remedial Design Site Layout", Drawing 3, "Site Grading and Drainage Plan", and Drawing 5, "Details Sheet 1 of 3", are included. Final design drawings will be provided in the FRDR.

4.0 SOUTHERN SHALLOW GROUNDWATER AREA

4.1 Overview

Additional PDI activities for the Southern Shallow Groundwater Area (SSGA) were completed in accordance with the PDI Work Plan Addenda, dated September 7, 2011 and April 27, 2012. The PDI field work was completed in two separate field mobilizations/phases. The first phase (Phase 1) of this PDI work was completed in November 2011 and entailed the completion of a membrane interface probe/electrical conductivity (MIP/EC) investigation, and the performance of a treatability study to assess the site-specific efficacy of ZVI in reducing elevated concentrations of VOCs in the SSGA at the Site.

The Phase 2 field investigation included a number of additional borings to enhance our understanding of the geologic, hydrogeologic and geotechnical properties of the soils in this area. The additional investigations that were competed were targeted at providing information to allow design of the current concept of a barrier wall with ZVI gates to address impacted groundwater.

4.2 Pre-Design Investigation Results

The following field investigations were undertaken to better understand ground conditions in the SSGA:

- MIP/EC Investigation
- Soil borehole investigation including soil sampling for VOCs
- Geotechnical borehole investigation including soil sampling
- Groundwater monitoring well installation

In addition, a groundwater bench scale treatability study was completed to assess the Site-specific efficiency of ZVI in reducing concentrations of VOCs. Details of the findings of these investigations are provided below.

4.2.1 Phase 1 - MIP/EC Investigation

A field screening investigation was conducted using direct push methods with a MIP/EC downhole instrument. This method allows rapid assessment of in-situ chemistry conditions and has been used at the SSGA to aid in selection of borehole sites.

The MIP/EC investigation was conducted by Columbia Technologies of Baltimore, Maryland with direct push assistance from Frontz Drilling of Wooster, Ohio (Frontz) from November 14, 2011 through November 18, 2011. A Golder field inspector was available onsite during all MIP/EC operations to monitor investigation results and make decisions regarding probe placement based on information obtained during the investigation.

A total of 20 MIP/EC probes were conducted during the four day field program. One probe location, SB-11-M06, originally completed on November 15, 2011, was repeated on November 18, 2011 (logged as "SB-11-M06A") to confirm results noted in the earlier log.

Figure 4-1 provides the surveyed locations of the MIP/EC probe sites. Logs of each of the MIP/EC logs are provided in Appendix D.

4.2.2 Phase 2 - 2012 Drilling Program

4.2.2.1 Drilling, Sampling and Well Installation

Golder conducted a Phase 2 drilling program between the dates of July 9, 2012 and July 24, 2012 during which time nine soil borings (MW12-52 through MW12-60) and three geotechnical borings (SB12-61, SB12-62, and SB12-63) were drilled and sampled (Figure 4-1). Monitoring wells were installed in all of the nine soil borings during the same field program. All drilling was conducted by Frontz using a CME-750 ATV-mounted drill rig. Borings were installed for characterization of geological, hydrogeological and geotechnical ground conditions along the southern and eastern boundaries of the SSGA. Each well/borehole was geologically logged by a Golder field geologist. Soil samples were obtained from discrete intervals for VOC analysis. Discrete and composite samples were also collected for geotechnical soil parameters. Borehole locations, proposed drill depths and sampling rationale were provided to the Agencies in a letter dated April 27, 2012 for approval prior to initiating the field program.

Upon completion of drilling and sampling at each well/borehole, the boring was either completed as a monitoring well or grouted to ground surface to prevent vertical cross-contamination between hydrogeological units (geotechnical borings). Outer 8-inch steel casings were also installed in wells MW12-52 through MW12-56 and MW12-58 at preselected intervals based on MIP data and field observations, and grouted to ground surface to mitigate vertical cross-contamination between hydrogeological units. Table 4-1 provides a summary of the screened interval for each of the monitoring wells installed. All wells were installed with 2-inch PVC casing and 0.01-inch slotted screens. Borehole and monitoring well installation logs are provided in Appendix A.

Table 4-1 Phase 2 Monitoring Well Summary Information

Well ID	Date Installed	Northing	Easting	Ground Surface (MSL)	Top of Casing (MSL)	Well Depth (FT BGS)	Bottom Depth of Outer Steel Casing (FT BGS)	Well Screen Interval (FT BGS)
MW12-52	7/24/2012	458400.51663	2444655.65590	1191.13	1192.96	21	15	19-21[1]
MW12-53	7/24/2012	458389.36615	2444670.64932	1190.75	1192.48	29.5	24	27.5-29.5
MW12-54	7/19/2012	458409.25587	2444661.61499	1191.32	1192.93	41	34	36-41[1]
MW12-55	7/16/2012	458650.28536	2445000.00971	1196.12	1197.69	29	20	24-29[1]

Well ID	Date Installed	Northing	Easting	Ground Surface (MSL)	Top of Casing (MSL)	Well Depth (FT BGS)	Bottom Depth of Outer Steel Casing (FT BGS)	Well Screen Interval (FT BGS)
MW12-56	7/13/2012	458673.45649	2445015.14984	1195.21	1197.11	44.5	35	39.5-44.5[1]
MW12-57	7/17/2012	458372.34798	2444698.60454	1189.62	1191.51	15	NA	10-15
MW12-58	7/18/2012	458362.57306	2444712.80021	1189.48	1191.22	40	19	35-40
MW12-59	7/16/2012	458313.29114	2444780.79660	1185.41	1187.28	37	NA	27-37
MW12-60	7/10/2012	458847.37600	2445154.04053	1181.39	1183.40	15	NA	10-15

Notes:
FT. BGS: Feet Below Ground Surface
MSL: Mean Sea Level
NA - Not Applicable
[1] - Due to hydrogeologic/geologic observations screen intervals were modified from proposed screen intervals

4.2.2.2 Monitoring Well Development

Well development commenced following installation of monitoring wells and continued after the final well installation. Development was conducted over the course of 14 days (from July 15 to August 1) by purging via bailer or a submersible pump with dedicated tubing. Repeated attempts were made to develop the Phase 2 wells (MW12-52 through MW12-60) during low water table conditions (field documentation included as Appendix E). Surge blocks were not employed due to the presence of fine-grained sediments and low water conditions. Only wells MW12-53 and MW12-58 were developed successfully after 30-43 well volumes were removed (see Table 4-2).

Monitoring wells MW12-53 and MW12-58 differed from the other wells installed during the Phase 2 work in that purging could be maintained without completely drawing the water column down to the pump intake. Between one to three well volumes per day could be removed from the remaining wells [excepting shallow wells MW-12-57 (installed on July 17, 2012) and MW-12-60 (installed on July 10, 2012[13])] before they were drawn down to a water column of less than 1 foot. Typical recharge only allowed enough recovery for one development cycle attempt per well per day. No significant reduction in the amount of sediment was noticed during development activities in these wells.

[13] These wells were still dry when Golder demobilized from the site on August 2, 2012.

Table 4-2 Well Development Summary

Well ID	Number of Gallons Removed	Number of Well Volumes Removed	Number of Times Purged Dry	Constructed Screen Interval of Well [ft bgs]	Well Development Completed [Y/N]
MW12-52	5.6	4.3	4	19-21	N
MW12-53	55	30	0	27.5-29.5	Y
MW12-54	19.5	5.9	6	36-41	N
MW12-55	23.5	14	7	24-29	N
MW12-56	26.3	8.8	10	39.5-44.5	N
MW12-57	0	0	Always dry	10-15	N
MW12-58	141	43	1	35-40	Y
MW12-59	36	11	7	27-37	N
MW12-60	0	0	Always dry	10-15	N

The remaining wells will be developed when hydrogeological conditions improve (anticipated to be in October 2012).

4.2.2.3 Correlation of MIP/EC with Borehole Investigation Results

Electrical conductivity signatures (EC) obtained from the MIP/EC investigation were used as an indication of relative grain size to help design the Phase 2 drilling approach. Low EC signatures are generally representative of clean sands and high EC signatures indicate finer grained sediments (silts and clays). The lithologies encountered during geologic logging of materials recovered from continuous split spoon samples correlated to this general EC signature. Following receipt of the laboratory results of grain size analysis (anticipated at end of September 2012) from geotechnical soil samples a more detailed analysis will be conducted of the MIP data.

4.2.3 Soil Sampling Results

The Phase 2 field work that commenced in July 2012 included the collection of 11 soil samples that were analyzed for VOCs using method EPA 8260B. In accordance with the PDI Addendum Work Plan (Golder, 2012), the soil samples were collected to overall help further refine our understanding of the horizontal and vertical distribution of VOCs in the adsorbed (soil) and dissolved phase (groundwater) in the southern area to establish a stronger basis for the SSGA remedial design. This work was conducted based on the results from the MIP/EC investigation conducted in November 2011.

All soil samples collected were couriered under chain of custody documentation to Test America of North Canton, Ohio. Quality Assurance/Quality Control (QA/QC) samples were collected which included one rinsate blank, one field duplicate, one matrix spike/matrix spike duplicate and nine trip blanks. Figure 4-1 shows the location of the boring locations and a Sampling and Analyses Summary is provided in Table 4-3.

With the exception of soil sample MW12-55 (22 – 22.5 ft bgs), all other samples were selected from either the 6-inch interval exhibiting the highest photoionization detection (PID) reading or if there were no PID readings or elevated PID readings were present over the entire screened interval, the soil sample was collected from the depth corresponding to the mid-point of the well screen interval. There were no PID readings at nine locations[14]. A summary of the PID readings is included in Table 4-3 and is also included in the soil boring logs presented in Appendix A.

The soil analytical results, as validated by Golder, are presented in Table 4-4 and the data usability summary report (DUSR) is provided in Appendix F. The following provides a brief summary of these results:

- Total VOC concentrations from the four shallow samples collected generally from 12 to 14.5 feet bgs ranged from 18.3 parts per million (ppm) at MW12-52 (12.5-13 feet bgs) to non-detect in sample MW12-57 (13-13.5 feet bgs). Total VOC concentrations in samples MW12-55 (14-14.5 ft bgs) and MW12-60 (12.5-13 feet bgs) were 1.4 ppm and 0.008 ppm, respectively.
- Total VOC concentrations for the seven deeper soil samples ranged from 0.21 ppm at MW12-54 (38-38.5 feet bgs) to 0.0003 ppm at MW12-59 (32-32.5 feet bgs). Overall, where soils samples were collected at deeper intervals there is a decrease in total VOC concentrations except at MW12-54 (38-38.5 feet bgs) in which the concentration was higher (0.2 ppm) in the deepest sample.

As stated in the PDI Addendum Work Plan, the correlation of these results to the earlier MIP/EC investigation to further refine the horizontal and vertical distribution of VOCs within the SSGA is dependent on obtaining groundwater analytical results from the recently installed wells. Well development and sampling were attempted during this field mobilization, however moderate drought conditions limited the ability to finish this task. Well development and sampling is tentatively planned to occur in October 2012 when groundwater saturation conditions are expected to improve. Once sampling is performed, a brief letter report will be submitted 30 days after receipt of the analytical results. This letter report will communicate the results from groundwater sampling and provide further refinement of the interpretation of groundwater impacts in the SSGA.

4.3 Summary of Site Conditions

Geologic and hydrogeologic observations made from soils recovered during the Phase 2 drilling in the SSGA have been reviewed in combination with previous investigation results and are summarized in the following sections.

[14] At locations MW12-54 and MW12-55 (14 – 14.5 ft bgs), the PID readings observed were representative of background readings.

4.3.1 Geologic / Hydrogeological Setting

The SSGA is located on a broad topped topographic mound near the base of the eastern slopes of a northeast-southwest oriented topographic ridge. The regional surface terrain in this area is generally hummocky with numerous small ponds and swampy areas. Such terrain is indicative of glacial origin with the sediments overlying bedrock likely to be derived primarily from retreating ice sheets.

Evaluation of lithologies encountered in Phase 2 boreholes drilled in the SSGA show the overburden soils in the SSGA to be predominantly fine-grained. These soils have previously been identified as till. Consistent with previous investigation results, lithologies encountered in borehole logs in this area show evidence of localized sand layers that are underlain by relatively thick sequences of clay and silty clay. Sand layers within these sediments may vertically overlap each other. These sand layers do not appear to have lateral continuity across the entire SSGA.

Review of the Standard Penetration Test (SPT) results obtained during drilling show 'N values' for surficial sediments (generally from 0 to 15 foot depths) on the order of 10 to 25 which is indicative of stiff or compact sediments. Fine-grained sediments deeper than 15 feet commonly demonstrate 'N values' less than 10 (soft or loose) with occasional values less than 4 (very soft). Sediments closer to the depth of bedrock (refusal) are generally locally more compact. The layering of more compact materials overlying soft zones may indicate differing depositional environments with the softer zones (which are generally fine grained sediments) deposited in localized lakes or kettles and the overlying deposits (generally coarser grained) representing glacial tills that have been partially reworked by fluvial processes. The more compact sediments close to the bedrock interface may have been subjected to ice burial or be extremely weathered bedrock.

Recent drilling results and difficulties encountered with development of monitoring wells screened within the overburden sediments suggest that these sand layers include vertically and laterally discontinuous groundwater zones (i.e., perched groundwater conditions) that for the most part are disconnected from the underlying deeper groundwater aquifer. Previous groundwater chemistry data combined with the results of the MIP investigation suggest that the sand layers may be the primary pathways for contamination migrating from the general vicinity of the former production area.

4.3.2 Observed Shallow Groundwater and Surface Water Conditions

The Phase 2 field investigation was conducted during a period of low precipitation and moderate drought conditions. During this period the Site experienced the lowest rainfall conditions recorded since 2006 (Figure 4-2, below).

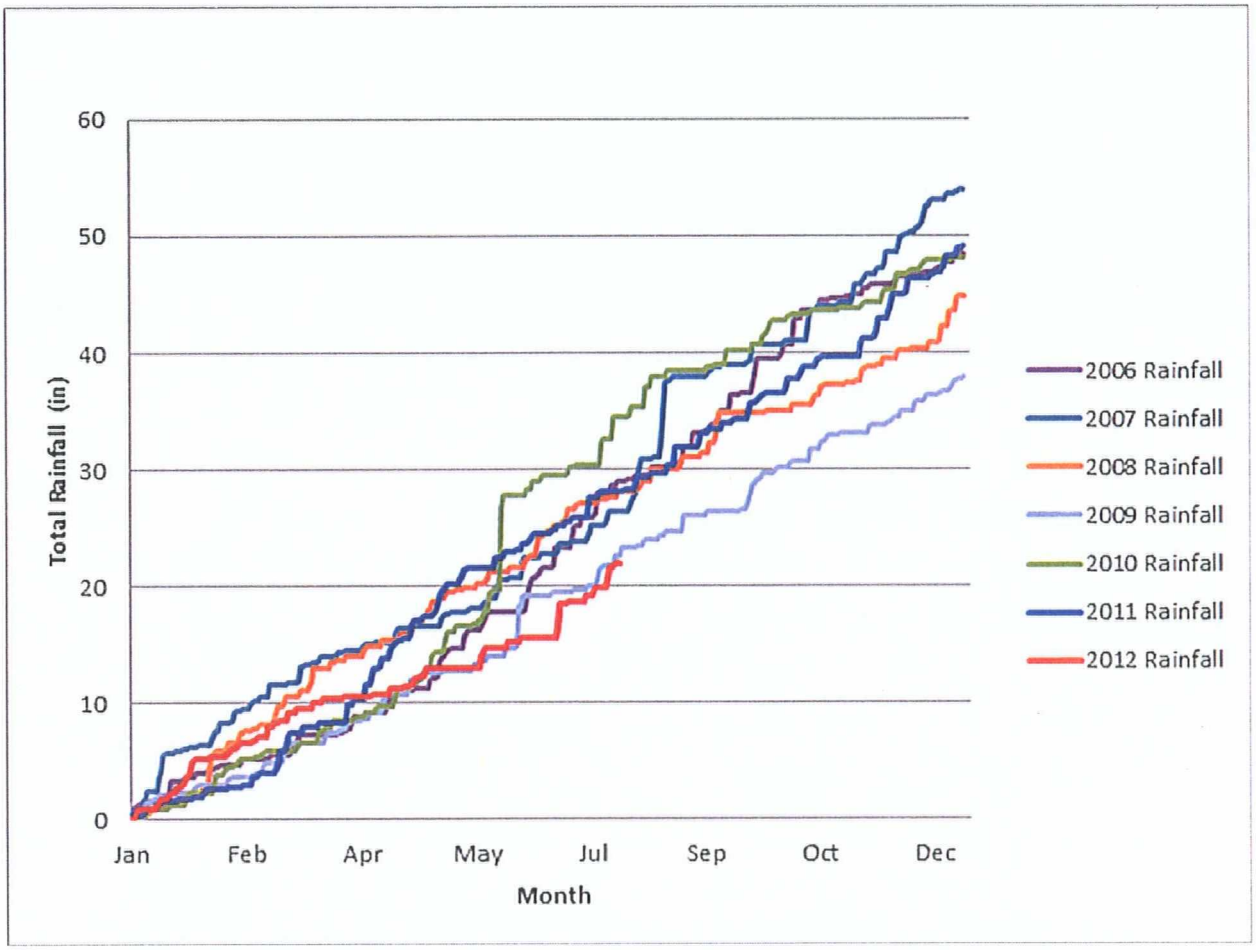


Figure 4-2 Cumulative Annual Precipitation in the vicinity of the Site (2006 – 2012)

During the Phase 2 monitoring well installation, lower groundwater levels than expected were encountered. In addition, higher than usual temperatures resulted in increased evapotranspiration, overall reducing the net precipitation infiltration in the subsurface. It is likely that low groundwater elevations noted at the Site are directly related to the recent reduced rainfall and increased temperature conditions.

As a result of these observed conditions and to better understand the relationship between rainfall, temperature, and groundwater conditions at the Site (as related to the overall remedial design), Golder made some enhancements to the field program that included monitoring several different hydrologic factors. These observations included:

- Synoptic water levels of select on and off-property wells
- Electronic data logger recordings in newly installed wells MW12-53, MW12-55, and MW12-59

- Electronic data logger recordings of water levels in a piezometer (SP-1) adjacent to the seep
- Visual inspections and logging of known seep locations
- Well development and recovery monitoring
- A photographic record of flow in Feeder Creek before, during, and after precipitation events

Golder began recording water levels at the locations described above on July 17, 2012 through August 1, 2012. A summary of water measurements obtained during this period is included as Appendix G. Overall bedrock groundwater elevations appeared to increase after July 26, 2012 while overburden groundwater was variable. Increasing trends were noted in some overburden wells while decreasing trends were identified in other overburden wells.

Figure 4-3 (below) presents the trends represented by spheres, the location of the sphere represents the well location, the color represents increase/decrease (yellow for increase, white for decrease), and the size of the sphere shows the number of days the water level increased/decreased from the prior day. For example if the water level in a well increased seven consecutive days out of eight days it appears as yellow with a radius of seven (the first day does not contribute). Alternatively, if the water level in a well decreased five days and then increased for the next two days it appears as white with a radius of three. Overburden wells in the southeastern portion of the Site showed increasing trends while other areas of the site seem to show weak negative trends. It should be noted that water levels in the vicinity of the newly installed Phase 2 wells would have been affected by well development efforts during this period.

Figure 4-3 Shallow Groundwater Elevation Trends by Location

During synoptic water level collection on and off-property, photographs and observations were collected along Feeder Creek and the seep. Seep observations were first recorded on July 23, 2012. These observations showed dry conditions at the seep location and very small amounts of standing water in the adjacent wetland area. A data logger was placed in seep area well SP-1 on July 25, 2012 (with the seep still exhibiting dry conditions) to obtain detailed information on shallow groundwater and assess how the seep responded to rainfall events.

On July 26, 2012 the Site and surrounding area experienced heavy thunderstorms and a daily precipitation level of 1.7 inches was recorded (Figure 4-4, hourly precipitation shown in red). The seep area showed no immediate response to the large rainfall/runoff recorded on property. It was not until July 30, 2012 (Figure 4-5, below) that the seep responded to the precipitation event. At this point visible seepage of groundwater could be seen emanating from the seep area at several locations. From July 30, 2012 to August 2, 2012 the area of seepage was seen to expand outward and downslope despite only minor amounts of precipitation during that period (approximately 0.2 inches total).

Observations at Feeder Creek were also documented during this time period (see Figure 4-5). At the onset of the observations the majority of the creek bed was dry/damp with a small area of standing water

close to the vicinity of the seeps. No surface flow was observed until immediately upstream of the confluence of Feeder Creek and Little Beaver Creek. These conditions remained constant until the large precipitation event on July 26, 2012 (1.7 inches). At this point the entire visible length of Feeder Creek contained sustained flowing water. Feeder Creek maintained continuous flow until August 1, 2012. At this time visible flow only present at the bend in the creek where it parallels Allen Road and the elevation of the stream bed begins dropping rapidly toward Little Beaver Creek.

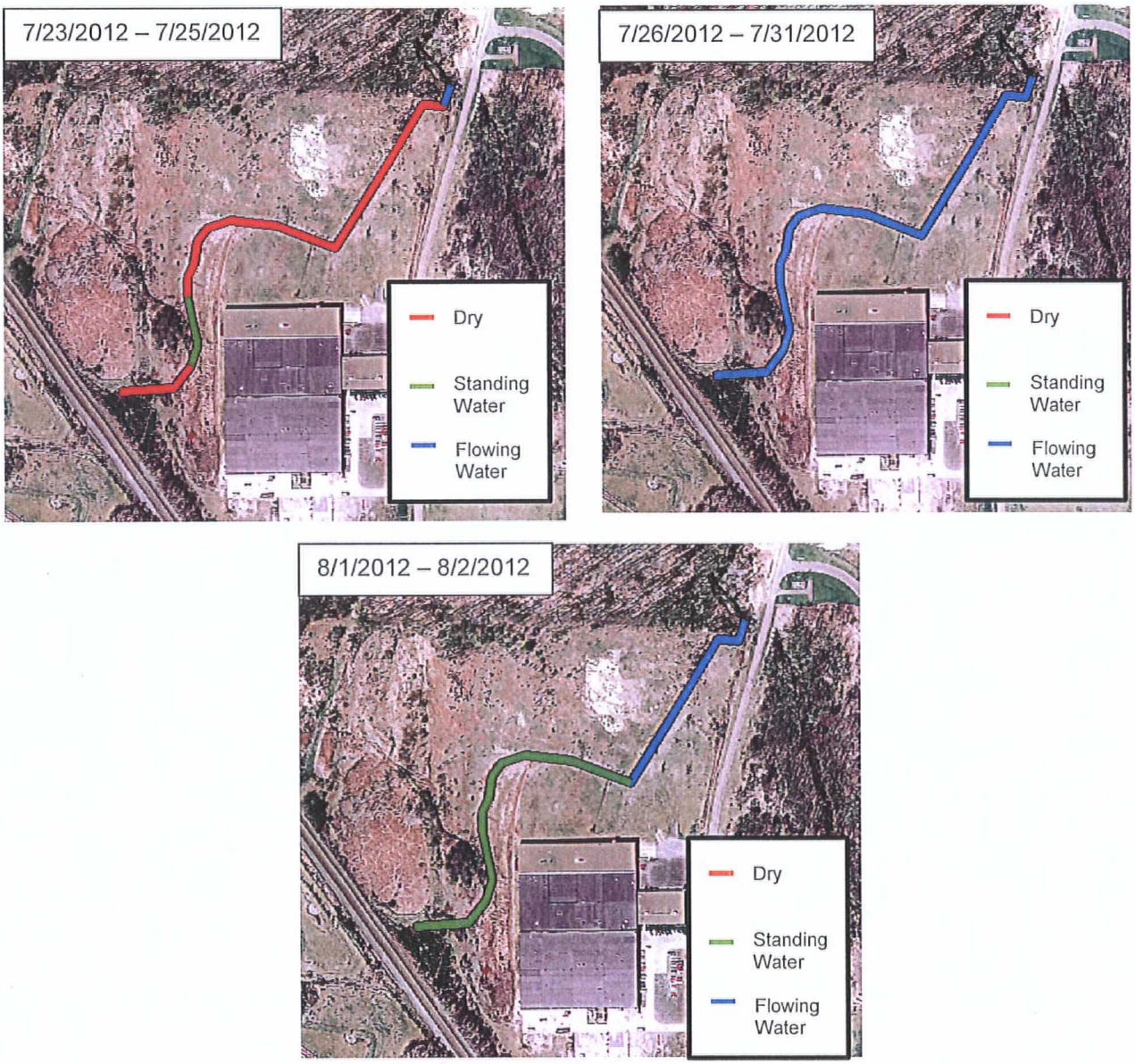


Figure 4-5 Feeder Creek Flow Conditions by Date

At the end of the field operation data loggers were installed in well SP-1 and Phase 2 wells TW12-53, TW12-55, and TW12-59 to continue long-term monitoring of seep and overburden groundwater conditions, particularly as they relate to Site precipitation.

4.4 Proposed Additional PDI Work

Identification of shallow perching groundwater conditions and associated seasonal dry shallow groundwater conditions has necessitated further investigation of the interaction between precipitation and shallow groundwater in the area of the SSGA. To this end, ROC and Golder recommends developing a balanced water budget model for the Site. Because the SSGA and the area west and north of the treatment plant comprise a topographic high, installing an impermeable cap in this area would be expected to remove recharge due to infiltration and result in lower water table conditions. A remedial design that includes an impermeable cap could drop the seasonal high unconfined groundwater below the zone of contamination in this area or significantly decrease the head of water driving migration of contaminants off property.

To better understand the effect of changing infiltration in this area, and therefore the effect of various potential capping designs, ROC and Golder proposes collecting one full year of detailed hydrologic data to develop a water budget for the Site. This data will be used to refine our understanding of the combined balance between precipitation and evapotranspiration / infiltration / runoff at the Site.

previous with data scale.

4.4.1 Collection of Seasonal Water Balance Data

The complex interaction of precipitation, runoff, evapotranspiration and infiltration with the elevation of the underlying unconfined groundwater table is complicated by seasonal temperature changes. During summer months, higher heat and longer periods of more intense sunshine increase evapotranspiration rates. During winter months, extended periods of below freezing temperatures can generate low infiltration conditions followed by increased infiltration rates as snow melts.

These various elements combine to produce a water balance that is reflected in the elevation of the unconfined groundwater table. Developing an understanding of the interaction of the water balance elements at various seasons can be used to anticipate the behavior of the water table beneath the SSGA and the Site in general as well as the impact on that water table of various design options.

Establishing a water budget for the site is based upon the assumption that there is a balance between water entering the Site hydrogeologic system as precipitation and water leaving the Site via evapotranspiration, runoff and infiltration. As infiltration increases, the water table responds by storing more water and locally rising in elevation. The local mounding effect increases the gradient and thereby promoting more rapid migration of groundwater outward from the mound. Over a long period of time there should be a balance between net influx and outflow of water at the Site.

4.4.1.1 Precipitation

Golder installed a dedicated rainfall gauge in the vicinity of the treatment plant to monitor Site specific precipitation during the course of one full year. The rainfall gauge (model RG-2500E from Omega Engineering Inc.) is an 8-inch tipping bucket type with a heater element to account for snowfall that monitors precipitation in increments of 0.01 inches and has data logger capabilities to allow acquisition of near real time data at the Site.

This device was installed on September 12, 2012. Rainfall data will be downloaded as needed.

4.4.1.2 Surface Water

Two flow monitoring stations (final design to be determined) will be installed in surface drainages to help quantify the runoff component of the Site water budget. No surface stream locations are available in the immediate vicinity of the SSGA and these locations are the closest locations that can be used to provide information to the water balance assessment. In addition, information obtained from these flow monitoring stations can be used to refine surface water drainage designs for the Eastern Area.

The proposed location of the surface flow monitoring stations is provided on Figure 4-6 (below).

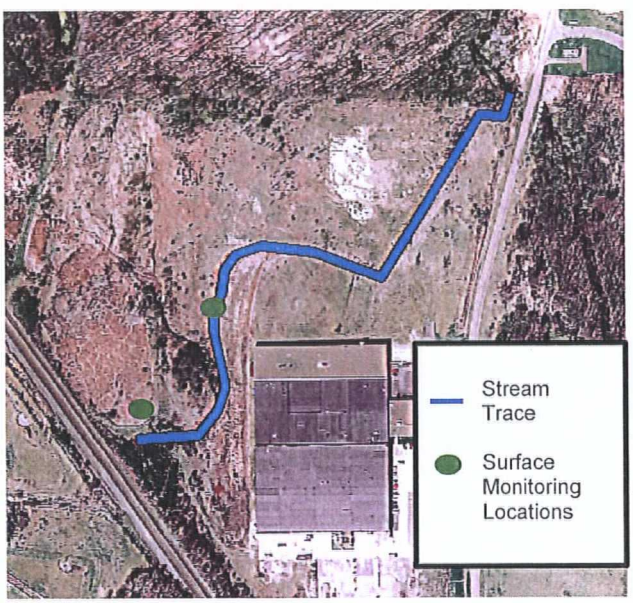


Figure 4-6 Proposed Surface Flow Monitoring Locations

4.4.1.3 Groundwater

Groundwater fluctuation will be monitored in select wells using a dedicated transducer with data logger. Data loggers will be configured to obtain water level measurements at approximately intervals sufficient to allow acquisition of detailed water level changes as well as maintain a minimum of 60 days worth of data

in the data logger memory (roughly 2 minute intervals). Data will be downloaded as needed to obtain a continuous record of water levels in each well being monitored for the course of one full year.

4.4.2 Wet Season Well Development and Sampling

Development of the new wells installed during the Phase 2 drilling program in the SSGA was not completed due to low water conditions (Section 4.2.2.2). This well development will be completed and the wells will be sampled for VOCs.

4.5 Treatability Study

Treatability tests were conducted to evaluate the site-specific efficacy of the planned ZVI treatment gates and determine key design parameters. The final report of these tests is provided in Appendix C. These treatability studies were performed to compare the reactivity and longevity of reactive materials under uniform and controlled conditions, and to estimate key ZVI design parameter such as the VOCs half-life (t1/2). Groundwater samples were collected from monitoring well TW06-04, located in the SSGA along the southwestern boundary of the property in November 2011. This Site groundwater was run through columns packed with different treatment material proportions and water samples were collected through ports along the column length.

Three ratios of ZVI/sand mixtures were evaluated in three separate columns to determine the optimum ZVI to sand ratio resulting in the most efficient and effective loading of reactive material (ZVI). The initial design of the treatability tests included ZVI/sand mixtures of 25%, 50%, and 75% ZVI, and a flow rate of approximately 0.13 mL/min. Following the first two sampling rounds, the treatability tests were modified to increase the flow rate and replace the 75% ZVI mixture with a 12% ZVI mixture, as the reactions were too fast for the original design to provide the desired data.

These tests provided specific VOC half-lives for Site groundwater, which are within the range of published values, and indicated that there is a potential for mineral precipitation to impact the life length of the iron, which will need to be taken into account during the design. The treatability tests provide the data anticipated to be necessary for a reactive barrier design, and no further testing is required.

4.6 Summary

Assessment of the Phase 2 field drilling program results shows that the shallow groundwater at the Site includes perched conditions and is contained wholly or in part within sand layers with limited lateral and vertical continuity that overlie a relatively thick sequences of fine-grained silts and clays. Review of historical groundwater chemistry results and Phase 2 soil sampling results suggests that the bulk of contamination appears to be contained within these upper sand layers that for the most part are under perched groundwater conditions. The potential exists to significantly reduce contaminant migration from the Site if infiltration to these upper sand layers can be managed.

In addition to developing an understanding of the variable nature of shallow groundwater in the SSGA, the data collected over one year will allow a more detailed assessment of seasonal variation in evapotranspiration rates at the Site. The current remedial design includes removal of trees and replacement with soil cover in areas affected by mirex. The potential exists for this remedial action to result in increased groundwater elevations as the trees are expected to remove a significant volume of water via evapotranspiration. Such an increase in groundwater levels could generate greater horizontal and vertical gradients at the Site resulting in potential increases to contaminant migration. This potential impact further reinforces the need to develop a clearer understanding of the hydrogeologic conditions in this complex area.

It is anticipated that remedial treatment of known contaminated areas (presenting as localized zones) will be in accordance with that presented in the ROD via injection of nZVI or mZVI and potentially enhanced by biological treatment as presented in Section 3.2. The concept of a barrier wall with ZVI gates may not be suitable and ROC/Golder is currently evaluating alternative remedial options.

Following acquisition of one full year of hydrologic data (presented above) Golder will compile a water balance for the SSGA and assess the impacts of various remedial treatment and design options to produce our finalized remedial design for this area. The final design will be presented as a Supplemental Final Remedial Design Report (FRDR) including details specific to the SSGA.

5.0 SUMMARY

This IRDR provided an update of the Former Ponds 1 and 2 S/S/S, Eastern Area and SSGA remedies.

The following provides a summary of the results presented in this IRDR:

Stabilization and solidification component of the Ponds 1 and 2 S/S/S

- Geotechnical investigations have demonstrated that the anticipated sand lenses are intermittent occurrences of intermixed gravel which is not present in significant quantities that would impact the solidification and stabilization of Former Ponds 1 and 2
- With the exception of RW-11-51, the presence of DNAPL is predominately noted by oil sheens and staining and that it is not present in recoverable quantities based on the three additional temporary wells that were installed at boring locations SB-12-G10, SB-12-G13, and SB-12-G15
- Composite soil samples were developed from the soil boring program to provide sludge and fine-grained soils exhibiting representative contaminant characteristics for the S/S/S design mix laboratory testing
- Compatibility, strength and permeability testing was completed on select bentonite-cement soils mixtures with the Former Ponds 1 and 2 soils. Based on this testing the recommended mix mixture uses a 5% bentonite slurry with between 4 and 6% cement additive
- Prescriptive stripping specification will be provided in the FRDR to capture off-gases resulting from the mixing/stripping process

Eastern Area - Bedrock Groundwater nZVI remediation and Eastern Shallow Collection Trench

- The injection well layout has been modified to move the array of injection wells to the eastern side of the railway corridor so that injections may be initiated prior to Former Ponds 1 and 2 S/S/S activities, to avoid interference with S/S/S activities, and to permit the performance assessment wells to be located closer to the injection wells
- The injection well layout has been modified to move two injection wells into the Former Ponds 1 and 2 area; these wells will be installed following completion of S/S/S activities
- The program has been expanded to use both nZVI and mZVI injection media
- Well construction, construction sequencing, hydrofracturing, injection program, performance standards, and treatment evaluation details were provided for the Bedrock Groundwater Remedy
- The Eastern .Groundwater Collection Trench configuration has been modified, as previously discussed with the Agencies, and the groundwater trench and the surface stormwater flow channel have now been incorporated into one system heading in a northerly direction to an outlet to Feeder Creek

Southern Shallow Groundwater

- A MIP/EC investigation has been completed in accordance with the PDI Work Plan Addenda, dated September 7, 2011, and April 27, 2012. The field drilling and sampling program provided detailed hydrogeologic and geologic information and constituent

contamination of soils in the area. Due to excessively dry conditions, groundwater sampling and testing has been deferred and additional monitoring has been proposed;

- The Treatability Study has been successfully completed and provides the data (contaminant half-lives for ZVI/sand mixtures) as described in the work plan.
- Due to the groundwater conditions observed during the PDI activities, the discovery of perched water conditions in the area, and the proposed additional monitoring, it is recommended that the Southern Groundwater Area Remedial Design be submitted as a later supplement to FRDR. This will permit the Design and Construction of the Final Remedy to move forward while additional design information is gathered for the Southern Shallow Groundwater.

6.0 REFERENCES

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Table 3-1
Approximate Well Construction Details
Interim Remedial Design Report
Former Nease Chemical Site
Salem, Ohio

Proposed Well ID	Location	Purpose	Well Construction Details										
			Approximate Depth to Bedrock (ft bgs)	Approximate Depth to MKS (ft bgs)	Approximate Top of Borehole (ft bgs)	Approximate Bottom of Borehole (ft bgs)	Length of Borehole	Anticipated Depth of Well (feet)	Diameter (inches)	Casing Material	Anticipated Depth of Casing (feet)	Casing Schedule Number	Well Screen
IW-1	Source Area	Injection Well	20	40	45	55	10	55	8	PVC	40	40	open borehole
IW-2	Source Area	Injection Well	20	40	45	55	10	55	8	PVC	40	40	open borehole
IW-3	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-4	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-5	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-6	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-7	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-8	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-9	East of Railway Tracks	Injection Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
IW-10/NZVI-5	Downgradient Core	Injection Well	10	18	23	45	22	45	8	PVC	18	40	open borehole
IW-11	Downgradient Core	Injection Well	10	10	20	40	20	40	8	PVC	10	40	open borehole
IW-12	Downgradient Core	Injection Well	10	10	20	40	20	40	8	PVC	10	40	open borehole
AW-A	East of Railway Tracks, proximal to IW-9	Performance Assessment Well; Hydrofracturing Monitoring Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
AW-B	East of Railway Tracks, proximal to IW-9	Performance Assessment Well; Hydrofracturing Monitoring Well	10	20	25	45	20	45	8	PVC	20	40	open borehole
AW-1	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-2	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-3	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-4	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-5	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-6	East of Railway Tracks	Performance Assessment Well	10	20	35	55	20	55	8	PVC	20	40	open borehole
AW-7	Downgradient Core	Performance Assessment Well	10	10	30	45	20	45	8	PVC	10	40	open borehole

Notes:
Depths are approximate to the nearest 10 feet below ground surface, with the exception of NZVI-5/IW-10, for which borehole information is available. Actual depths will vary according to observations made during well installation
ft bgs - Feel below ground surface
MKS - Middle Kittanning sandstone
PVC - Polyvinyl Chloride

Prepared by: HAL 8/30/2012
Checked by: FG 9/18/2012

Table 3-2
Initial ZVI Injection Estimates
Interim Remedial Design Report
Former Nease Chemical Site
Salem, Ohio

NZVI Injection		Wells Within the 100,000 µg/L Contour	Wells Within the 50,000 µg/L Contour
Design Parameters			
Aquifer Thickness	ft	20	20
Length of Treatment Zone	ft	35	35
Width of Treatment Zone	ft	35	35
Porosity		0.1	0.1
VOCs total Concentration	µg/L	100,000	50,000
Calculation			
Volume of water within Treatment Zone	L	69,384	69,384
Volume of water within Treatment Zone	gal	18,259	18,259
Mass of VOCs to be Treated	kg	6.9	3.5
NZVI efficiency (n)	%	15.0	15.0
Mass of NZVI Required (M = 3 x VOCs / n)	kg	139	69

Prepared by: HAL 8/30/2012
Checked by: FG 9/18/2012

Notes:

Mass estimates of ZVI needed are approximate and are based on an average stoichiometric electron demand from concentrations observed in NZVI-5 in June, 2009. Actual inital injection masses may be adjusted based on baseline sampling results and observations made during well construction.

ft - feet
µg/L - micrograms per liter
kg - kilograms

Table 4-3
Summary of Soil Analytical Testing
Interim Remedial Design Report
Former Nease Chemical Site
Salem, Ohio

Membrane Interface Probe Location	Sample ID	Date	Sample Depth (FT - BGS)	Sample Analyses[1]	Quality Assurance/Quality Control Samples[2]	PID Reading (PPM)
SB-11-M15	MW12-52	7/23/2012	12.5-13.0	VOC	MW12-52FD	3.2
	MW12-52	7/24/2012	19.0-19.5	VOC		0
	MW12-53	7/24/2012	28.5-29.0	VOC		0.7[3]
	MW12-54	7/20/2012	38.0-38.5	VOC		1.6[3]
SB-11-M03	MW12-55	7/9/2012	14.0-14.5	VOC		7.6
	MW12-55	7/10/2012	22.0-22.5[4]	VOC	MW12-55MS/MSD	0
	MW12-56	7/13/2012	42.0-42.5	VOC		0
SB-11-M14	MW12-57	7/17/2012	13.0-13.5	VOC		0
	MW12-58	7/18/2012	37.0-37.5	VOC		0
Between SB-11-M11 and SB-11-M13	MW12-59	7/16/2012	32.0-32.5	VOC		0
SB-11-M21	MW12-60	7/10/2012	12.5-13.0	VOC		0

Notes:

FT. BGS: Feet Below Ground Surface

PPM - Parts Per Million

FD - Field Duplicate

[1] - Soil samples analyzed using method EPA 8260B.

[2] - Other Quality Assuance/Quality Control samples consisted of nine (9) trip blank (TB) samples and one rinseate blank (RB) and analyzed using method EPA 8260B.

[3] - PID readings are representative of background readings.

[4] - The well screen was originally to be installed from 22 to 24 FT. BGS. After leaving the borehole open for several days there was no water observed in the borehole. The borehole was then extended to 31.5 FT. BGS and based on field conditions the well was screened from 24 to 29 FT. BGS. As shown on the borehole log, there were no PID readings (0.0 ppm) from the bottom of the outer casing (20 FT. BGS) to the bottom of the borehole. Therefore, the soil soil sample collected at 22 to 22.5 FT. BGS was analyzed.

Prepared by:	CJL	9/10/2012
Checked by:	SDM	9/18/2012

Table 4-4
Detected Validated Analytical Soil Results - July 2012
Interim Remedial Design Report
Former Nease Chemical Site
Salem, Ohio

Sample ID		MW12-52			MW12-52			MW12-52			MW12-53			MW12-54		
Sample Date		7/23/2012			7/23/2012			7/24/2012			7/24/2012			7/20/2012		
N=Normal, FD=Field Duplicate		N			FD			N			N			N		
Start Depth (feet)		12.5			12.5			19			28.5			38		
End Depth (feet)		13			13			19.5			29			38.5		
Parameter	Unit	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL
1,1,2,2-Tetrachloroethane	ug/kg	210	J	530	190	J	600							5.9	J	4.6
1,2-Dichlorobenzene	ug/kg	13000		530	9600		600							81	J	4.6
1,2-Dichloroethane	ug/kg	110	J	530	77	J	600							6.3	J	4.6
1,4-Dichlorobenzene	ug/kg	130	J	530	79	J	600									
Benzene	ug/kg													0.55	J	4.6
Carbon Disulfide	ug/kg							4.8	J	6.8	3.7	J	5	3.3	J	4.6
Chlorobenzene	ug/kg	1000		530	840		600							15	J	4.6
Chloroform	ug/kg	62	J	530	37	J	600							1.5	J	4.6
cis-1,2-Dichloroethene	ug/kg	890		530	540	J	600							48	J	4.6
Cyclohexane	ug/kg							0.54	J	14				0.49	J	9.2
Ethylbenzene	ug/kg				13	J	600							0.28	J	4.6
Isopropylbenzene	ug/kg													0.22	J	4.6
Methyl Cyclohexane	ug/kg							0.76	J	14				1.1	J	9.2
Methylene Chloride	ug/kg							2.4	J	6.8	5		5			
Tetrachloroethene	ug/kg	2500		530	1800		600	2.2	J	6.8	1.5	J	5	39	J	4.6
Toluene	ug/kg	37	J	530										0.3	J	4.6
trans-1,2-Dichloroethene	ug/kg													0.46	J	4.6
Trichloroethene	ug/kg	350	J	530	250	J	600	0.92	J	6.8				11	J	4.6

Notes:
Only detected results are shown.
RDL - Reporting Detection Limit
Qual - Interpreted Qualifier
ug/kg - micrograms per kilogram
J - Result is estimated

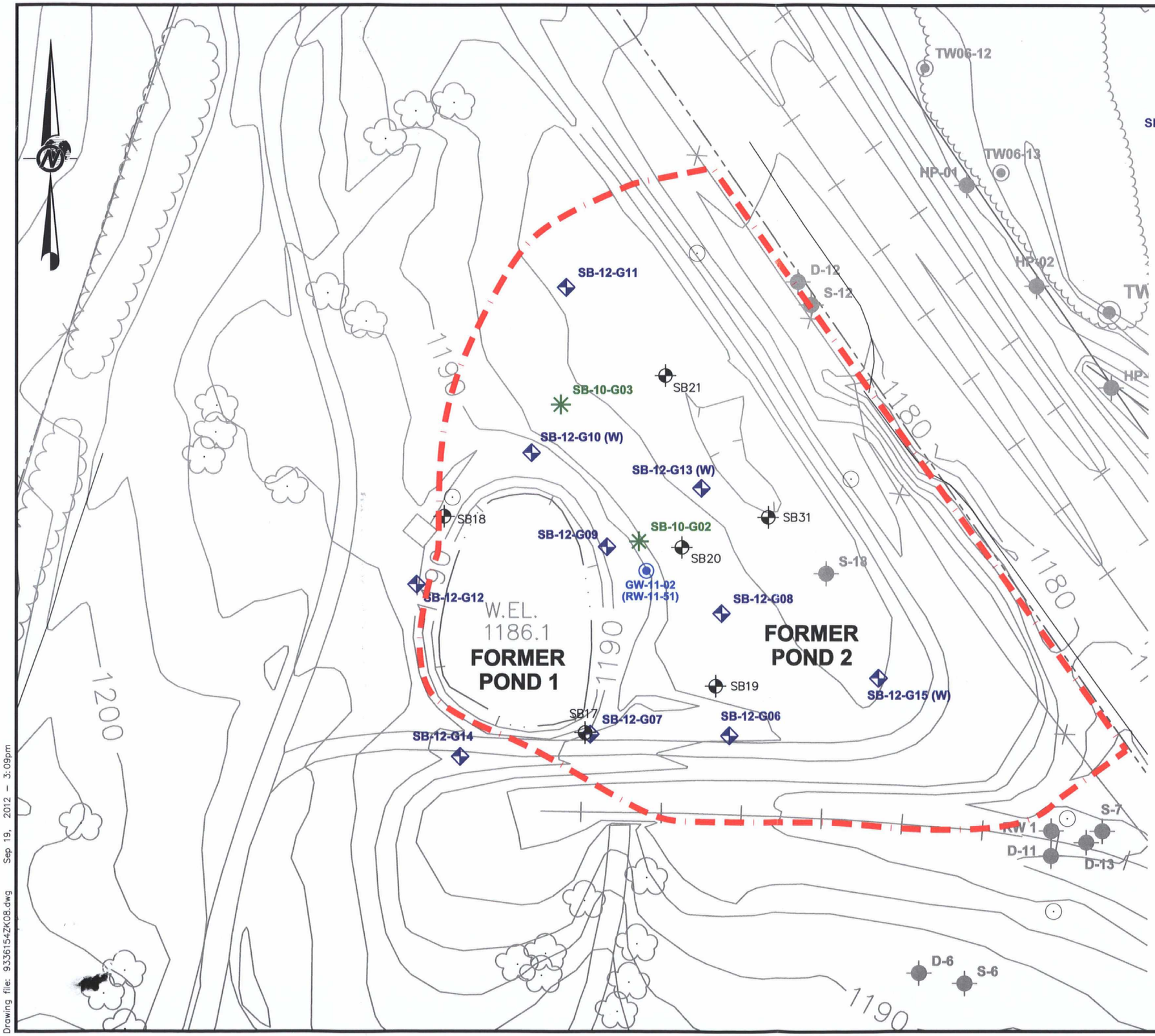
Prepared by: AMZ 9/11/2012
Checked by: JAB 9/11/2012

Table 4-4
Detected Validated Analytical Soil Results - July 2012
Interim Remedial Design Report
Former Nease Chemical Site
Salem, Ohio

Sample ID		MW12-55			MW12-55			MW12-56			MW12-57			MW12-58			MW12-59			MW12-60		
Sample Date		7/9/2012			7/10/2012			7/13/2012			7/17/2012			7/18/2012			7/16/2012			7/10/2012		
N=Normal, FD=Field Duplicate		N			N			N			N			N			N			N		
Start Depth (feet)		14			22			42			13			37			32			12.5		
End Depth (feet)		14.5			22.5			42.5			13.5			37.5			32.5			13		
Parameter	Unit	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL	Result	Qual	RDL
1,1,2,2-Tetrachloroethane	ug/kg																					
1,2-Dichlorobenzene	ug/kg																					
1,2-Dichloroethane	ug/kg	1200		240													0.34	J	4.7			
1,4-Dichlorobenzene	ug/kg																					
Benzene	ug/kg	190	J	240																		
Carbon Disulfide	ug/kg							3	J	4.5												
Chlorobenzene	ug/kg																					
Chloroform	ug/kg																					
cis-1,2-Dichloroethene	ug/kg																					
Cyclohexane	ug/kg																			0.42	J	11
Ethylbenzene	ug/kg																					
Isopropylbenzene	ug/kg																					
Methyl Cyclohexane	ug/kg	20	J	480																0.63	J	11
Methylene Chloride	ug/kg				2.2	J	4.7	0.76	J	4.5										7	J	5.3
Tetrachloroethene	ug/kg																					
Toluene	ug/kg																			0.29	J	5.3
trans-1,2-Dichloroethene	ug/kg																					
Trichloroethene	ug/kg													0.47	J	4.6						

Notes:
Only detected results are shown.
RDL - Reporting Detection Limit
Qual - Interpreted Qualifier
ug/kg - micrograms per kilogram
J - Result is estimated

Prepared by: AMZ 9/11/2012
Checked by: JAB 9/11/2012



LEGEND

- APPROXIMATE PROPERTY LINE
- PROPOSED LIMITS OF S / S / S TREATMENT AREA
- SB-12-G11 — 2012 MACRO-CORE BORING (SEE REFERENCE 3)
- SB-12-G10 (W) — 2012 MACRO-CORE BORING WITH TEMPORARY MONITORING WELL (SEE REFERENCE 3)
- GW-11-02 — GEOPROBE (2011) (SEE REFERENCE 4)
- SB-10-G03 — 2010 GEOTECHNICAL BORING LOCATION (SEE REFERENCE 5)
- SB–17 — SOIL BORING (1990) (SEE REFERENCE 6)
- MONITORING WELL
- MONITORING WELL (SCREENED IN OVERBURDEN)
- MONITORING WELL (SCREENED IN WASHINGTONVILLE SHALE)
- TEMPORARY MONITORING WELL (SCREENED IN OVERBURDEN)
- SE GROUNDWATER MONITORING WELL INSTALLED IN 2009/2010 (SCREENED IN OVERBURDEN)
- DNAPL DELINEATION WELL (GROUNDWATER NOT SAMPLED)
- DEEP DNAPL DELINEATION WELL (GROUNDWATER NOT SAMPLED)

REFERENCES

1.) TOPOGRAPHIC BASE MAP TAKEN FROM AUTOCAD FILE CREATED BY HOWELLS AND BAIRD, INC., DATED 06/14/95, DATE OF AERIAL PHOTOGRAPHY 04/06/95.

2.) PROPERTY LINE TAKEN FROM DIGITAL CAD FILE TITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," COMPILED FROM AERIAL PHOTOGRAPHY, DATED 04/06/06, PROVIDED BY HOWELLS & BAIRD, INC.

3.) LOCATION OF "SB-12-G11" SERIES MACRO-CORE BORINGS AND "SB-12-G10(W)" SERIES MACRO-CORE BORING WITH TEMPORARY MONITORING WELLS ARE FROM A FIELD SURVEY CONDUCTED BY HOWELLS & BAIRD, INC.

4.) LOCATION OF GW-11-02 GEOPROBE BORING IS FROM A FIELD SURVEY BY HOWELL & BAIRD, INC.

5.) GEOTECHNICAL SOIL BORINGS SB-10-G02 & SB-10-G03 WERE LOCATED USING HAND-HELD GPS.

6.) SOIL BORINGS SB-17 TO SB-21 & SB-31 WERE PERFORMED BY ERM IN JUNE AND JULY 1990 AND HAVE BEEN LOCATED ON THIS DRAWING FOR REFERENCE PURPOSES ONLY.

50 0 50
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
RÜTGERS ORGANICS CORPORATION
SALEM, OHIO

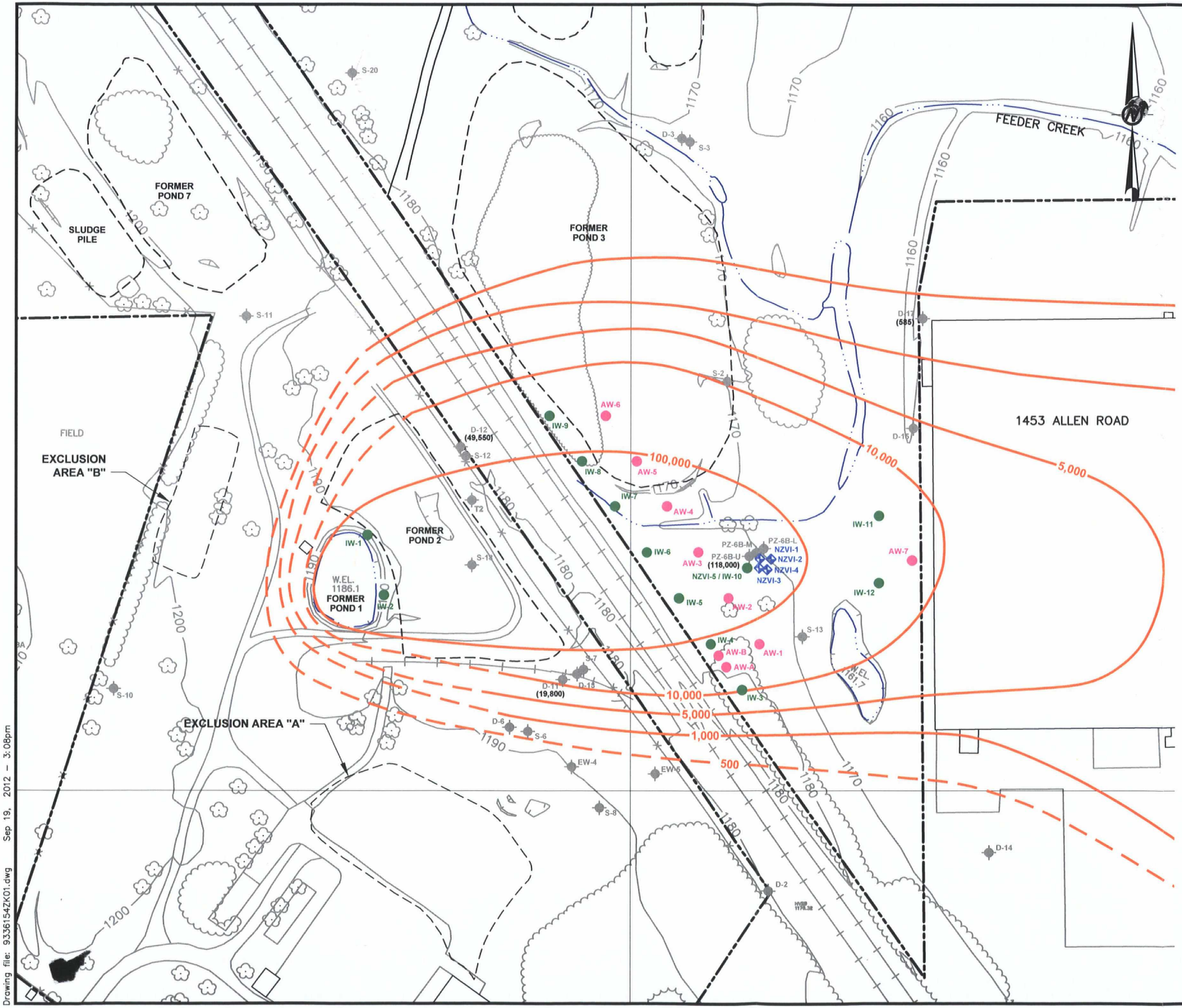
TITLE
GEOTECHNICAL BORING LOCATIONS

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		933-6154	FILE No.		9336154ZK08
DESIGN	CJL	09/19/12	SCALE	AS SHOWN	REV. 0
CADD	MJS	09/19/12			
CHECK	CPB	09/19/12			
REVIEW	SDM	09/19/12			

FIGURE 2-1

Drawing file: 9336154ZK08.dwg Sep 19, 2012 - 3:09pm



LEGEND

- APPROXIMATE PROPERTY LINE
- STREAM
- NZVI-4 — NZVI FIELD PILOT TEST MONITORING WELL
- IW-1 — EXISTING MKS NZVI INJECTION WELL
- AW-1 — PROPOSED MKS NZVI PERFORMANCE ASSESSMENT WELL
- 1,000 — VOC ISOCONCENTRATION CONTOUR OCTOBER/NOVEMBER 2010 (ug/L) (DASHED WHERE INFERRED)
- (258) — MEASURED TOTAL VOC CONCENTRATIONS (UG/L)
- S-12 — EXISTING MONITORING WELL

REFERENCES

1.) TOPOGRAPHIC BASE MAP TAKEN FROM AUTOCAD FILE CREATED BY HOWELLS AND BAIRD, INC., DATED 06/14/95, DATE OF AERIAL PHOTOGRAPHY 04/06/95.

2.) PROPERTY LINE TAKEN FROM DIGITAL CAD FILE TITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," COMPILED FROM AERIAL PHOTOGRAPHY, DATED 04/06/06, PROVIDED BY HOWELLS & BAIRD, INC.

3.) NZVI LOCATIONS TAKEN FROM DIGITAL CAD FILE 06-3337 NEASE.DWG, TITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," COMPILED FROM AERIAL PHOTOGRAPHY, DATED 04/06/06, PROVIDED BY HOWELLS & BAIRD, INC.

120 0 120
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

RÜTGERS ORGANICS CORPORATION
SALEM, OHIO

TITLE

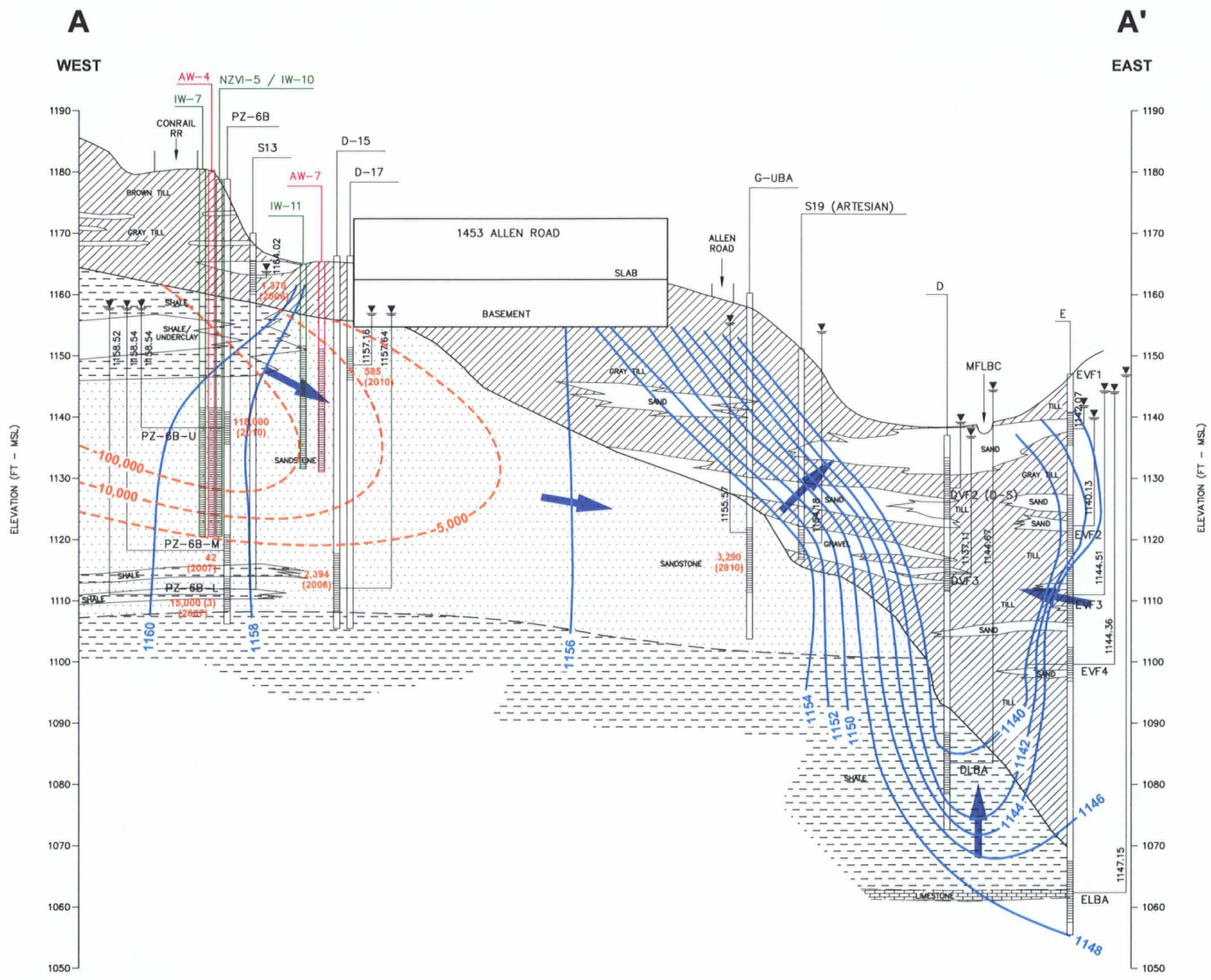
BEDROCK ZVI WELL LAYOUT

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		933-6154	FILE No.		9336154ZK01
DESIGN	HAL	09/19/12	SCALE	AS SHOWN	REV. 0
CADD	RG	09/19/12			
CHECK	CPB	09/19/12			
REVIEW	SDM	09/19/12			

FIGURE 3-1

Drawing file: 9336154ZK01.dwg Sep 19, 2012 - 3:08pm



100 0 100 200
HORIZONTAL SCALE FEET

10 0 10 20
VERTICAL SCALE FEET

VERTICAL EXAGGERATION X10

LEGEND

- S19 / IW-1 / AW-1 — BOREHOLE / PROPOSED INJECTION WELL / PROPOSED PERFORMANCE ASSESSMENT WELL
- TOP OF BOREHOLE
- GROUNDWATER ELEVATION (APRIL 1997)
- SCREEN
- BOTTOM OF BOREHOLE
- 5,000 — INTERPRETED VOC ISOCONCENTRATION CONTOUR (ug/L)
- 1,376 (2006) — MEASURED TOTAL VOC CONCENTRATIONS (ug/L) (DATE OF SAMPLE)
- 1154 — INTERPRETED EQUIPOTENTIAL CONTOUR (FT MSL)
- GROUNDWATER FLOW
- TILL
- MIDDLE KITTANING SANDSTONE
- WASHINGTONVILLE SHALE (UPPER) PUTNAM HILL SHALE ZONE (LOWER)
- VANPORT LIMESTONE

NOTES

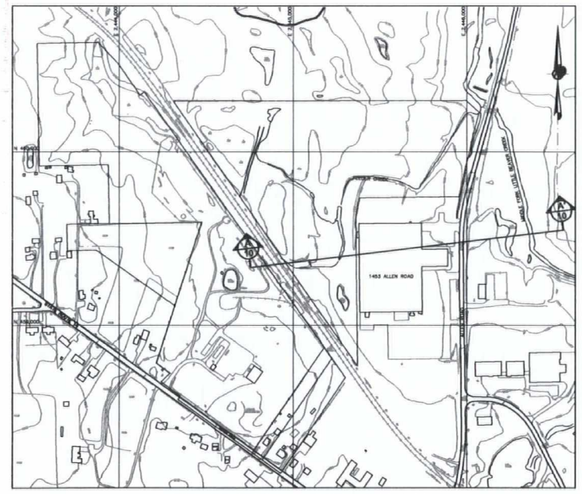
1.) WATER LEVEL DATA FROM APRIL 1997 SAMPLING EVENT.

2.) WELL LOCATIONS ARE APPROXIMATE AND HAVE BEEN PROJECTED TO THE SECTION LINE WHERE NECESSARY.

3.) PZ-6B-L NOT CONTOURED.

REFERENCE

1.) MODIFIED FROM GEOLOGIC CROSS SECTION A-A', PROVIDED BY ERM-MIDWEST INC., PROJECT No. 202-01-07, AUTOCAD FILE 07XSA.DWG.



CROSS SECTION LOCATION MAP

400 0 400 800
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

RÜTGERS ORGANICS CORPORATION
SALEM, OHIO

TITLE

INTERPRETED GEOLOGY AND GROUNDWATER CROSS SECTION WITH INTERPRETED EQUIPOTENTIAL CONTOURS

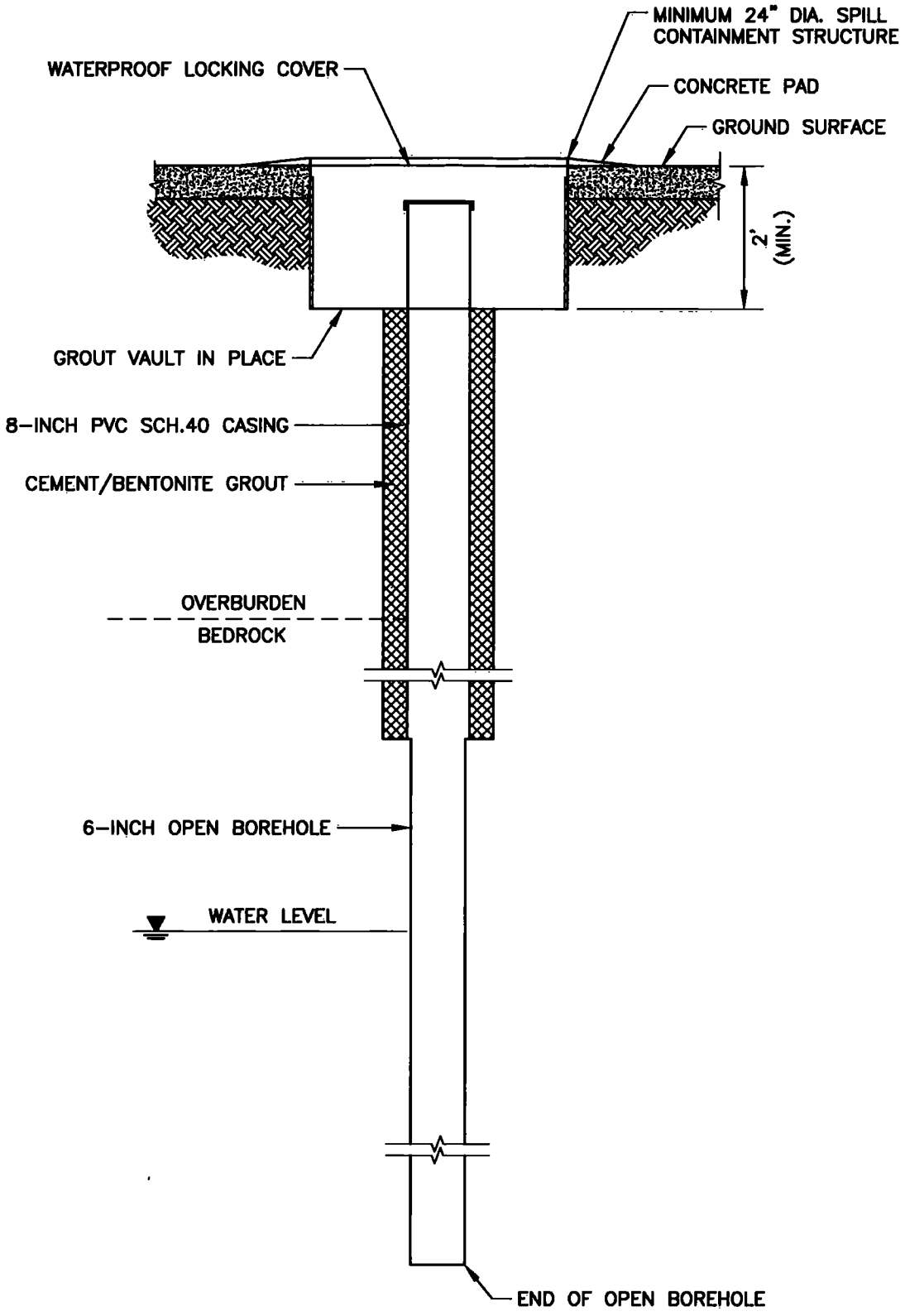
NJ Authorization #24GA28029100

Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	933-6154		FILE No.	9336154ZK02	
DESIGN	HAL	09/19/12	SCALE	AS SHOWN	REV. 0
CADD	RG	09/19/12			
CHECK	CPB	09/19/12			
REVIEW	SDM	09/19/12			

FIGURE 3-2

Drawing file: 9336154ZK02.dwg Sep 19, 2012 - 3:07pm



NJ Authorization #24GA28029100

Golder Associates
Mt. Laurel, New Jersey

FILE No.	9336154ZK06
PROJECT No.	933-6154
REV.	0
SCALE	AS SHOWN
DATE	09/19/12
DESIGN	HAL
CADD	RG
CHECK	CPB
REVIEW	SDM

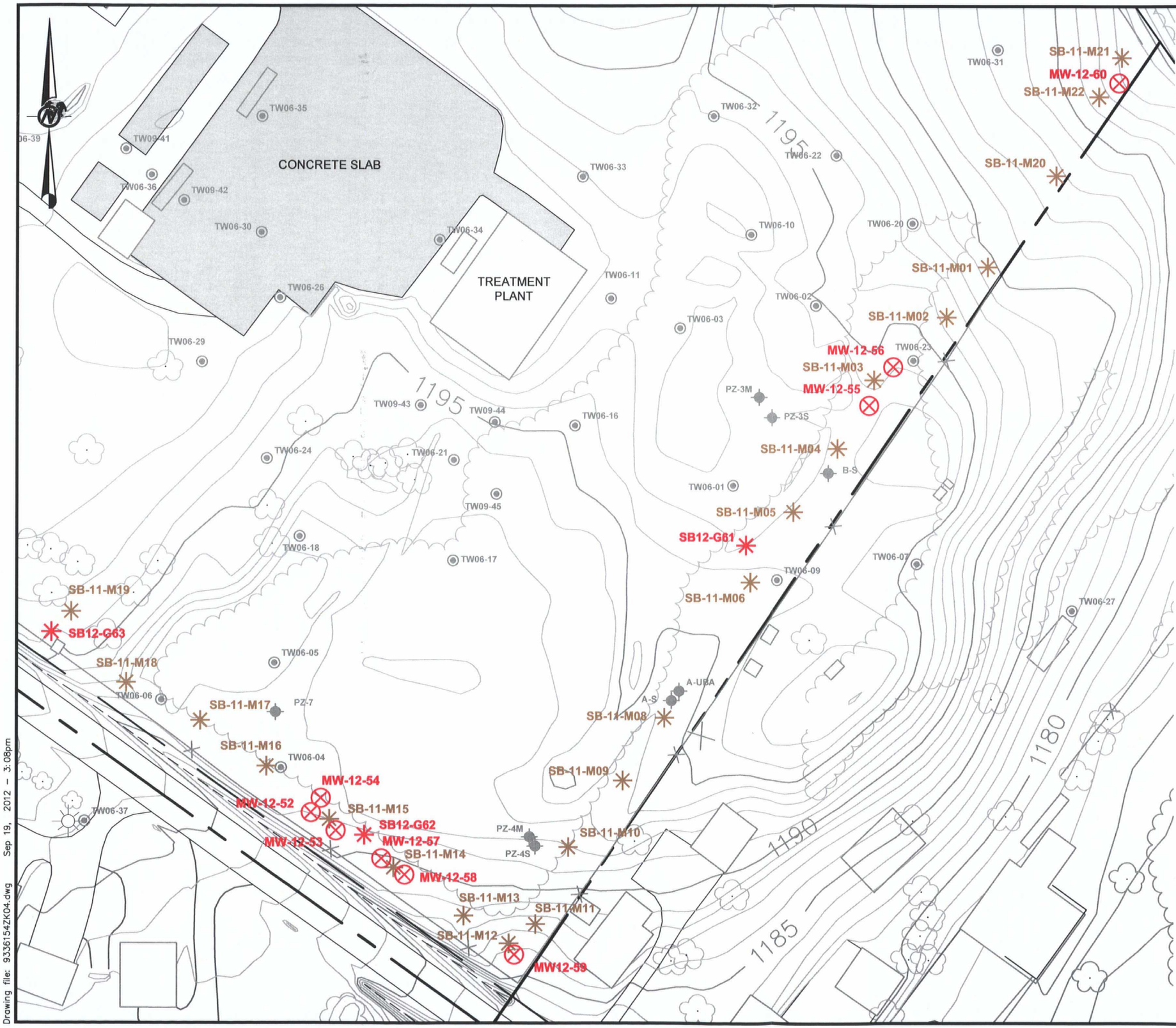
TITLE

TYPICAL ZVI INJECTION WELL

RÜTGERS ORGANICS CORPORATION

FIGURE 3-3

Drawing file: 9336154ZK06.dwg Sep 19, 2012 - 3:09pm



LEGEND

- APPROXIMATE PROPERTY LINE
- 1190 — TOPOGRAPHIC CONTOUR (2' CONTOUR INTERVAL)
- MW-12-52 — PDI MONITORING WELL AND GEOTECHNICAL BORING (2012) (SEE REFERENCE 2)
- SB-11-M02 — MIP / EC BORING (2011) (SEE REFERENCE 3)
- SB12-G61 — GEOTECHNICAL BORING (2012)
- PZ-3S — GROUNDWATER MONITORING WELL
- TW06-07 — TEMPORARY MONITORING WELL (SCREENED IN OVERBURDEN)

REFERENCES

1.) THIS BASE MAP IS FROM FILE 06-3337 NEASE.DWG, ENTITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," PREPARED BY HOWELLS & BAIRD, INC., DATED 04/06/06. ALL OTHER AREAS UTILIZE A TOPOGRAPHIC BASE MAP TAKEN FROM DIGITAL FILE CREATED BY HOWELLS AND BAIRD, INC., DATED 06/14/95, DATE OF AERIAL PHOTOGRAPHY 04/06/95.

2.) MONITORING WELL LOCATIONS (RUTGERS WELL LOCATIONS.PDF) MW12-52, MW12-53, MW12-54, MW12-55, MW12-56, MW12-57, MW12-58, MW12-59, AND MW12-60 SURVEYED BY HOWELLS & BAIRD, INC.

3.) MIP/EC BORING LOCATIONS (11-4522.PDF) SURVEYED BY HOWELLS & BAIRD, INC. SB-11-M07 WAS NOT COMPLETED.

4.) TEMPORARY MONITORING WELL LOCATIONS TW06-01 THROUGH TW06-07 TAKEN FROM CADD FILE 06-3337 NEASE.DWG, PROVIDED BY HOWELLS & BAIRD, INC.

5.) TEMPORARY MONITORING WELL LOCATIONS TW06-08 THROUGH TW06-11 AND TW06-15 THROUGH TW06-24, TW06-26 THROUGH TW06-37, TW06-39 AND TW06-40 PROVIDED BY HOWELLS & BAIRD, INC.

6.) TEMPORARY MONITORING WELL LOCATIONS TW09-41 THROUGH TW09-49 ARE FROM A FIELD SURVEY (FILE: "SAMPLING 2009.DOC") CONDUCTED BY HOWELLS & BAIRD, INC., DATED 11/02/09.

60 0 60
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT
RÜTGERS ORGANICS CORPORATION
SALEM, OHIO

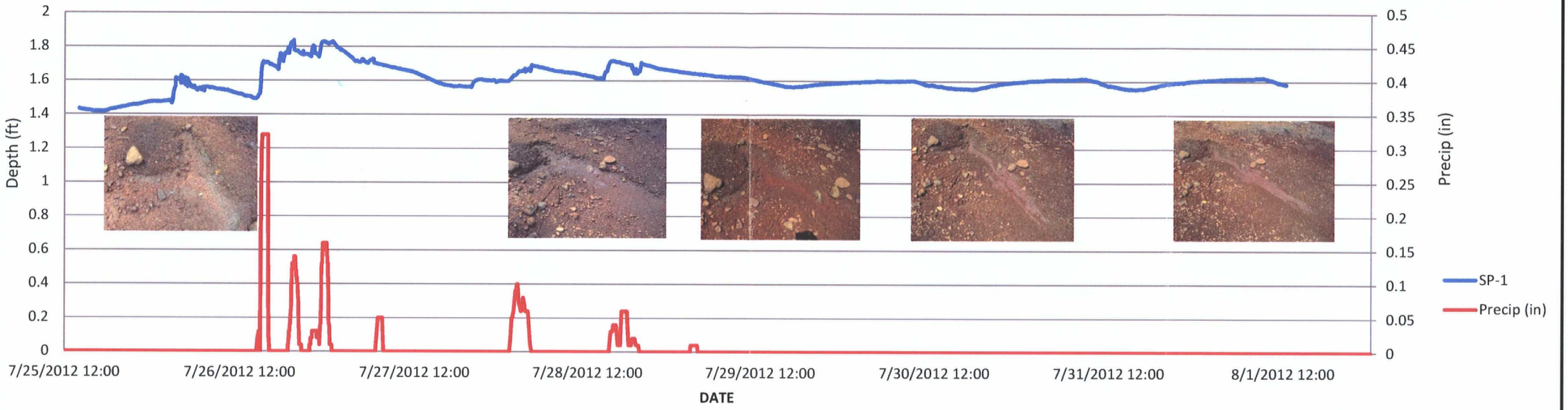
TITLE
PDI ADDENDUM INVESTIGATION LOCATIONS

Golder Associates
Mt. Laurel, New Jersey
NJ Authorization #24GA28029100

PROJECT No.		933-6154	FILE No.		9336154ZK04
DESIGN	CJL	09/19/12	SCALE	AS SHOWN	REV. 0
CADD	AM	09/19/12			
CHECK	CPB	09/19/12			
REVIEW	SDM	09/19/12			

FIGURE 4-1

Drawing file: 9336154ZK04.dwg Sep 19, 2012 - 3:08pm



REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW

PROJECT

Rutgers Organics Corporation

RÜTGERS ORGANICS CORPORATION
SALEM, OHIO

TITLE

HOURLY PRECIPITATION AND SEEP CONDITIONS

NJ Authorization #24GA28029100

Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		933-6154	FILE No.		9336154ZK07
DESIGN	WD	09/19/12	SCALE	AS SHOWN	REV. 0
CADD	AM	09/19/12			
CHECK	CPB	09/19/12			
REVIEW	SDM	09/19/12			

FIGURE 4-4

Drawing file: 9336154ZK07.dwg Sep 19, 2012 - 3:09pm

APPENDIX A

BORING AND MONITORING WELL INSTALLATION LOGS

PONDS 1 AND 2 BORING LOGS

RECORD OF BOREHOLE SB-10_G02

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 22.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME LC-55
DATE STARTED: 11/3/10
DATE COMPLETED: 11/3/10
WEATHER: Sunny

DATUM: Site
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 50 F

INCLINATION: -90
DEPTH W.L.: 7.2 ft
ELEVATION W.L.:
DATE W.L.: 11/3/10
TIME W.L.: 2:15 pm

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
0		0.0 - 2.0 Loose, Dark brown clayey fine SAND, dry, mild chemical odor	TOPSOIL			0	G1	2 IN SS	1-2-2-1	4	0.5 / 2.0	Sieve analysis 0 to 8 feet.
		2.0 - 4.0 Compact, Brown clayey fine SAND, dry, strong chemical odor	FILL		2.0	0	G2	2 IN SS	3-5-7-13	12	1.5 / 2.0	
5		4.0 - 6.0 same as above	FILL		4.0	3	G3 & G4	2 IN SS	9-9-9-10	18	1.5 / 2.0	Sieve analysis 5 to 8 feet (composite sample G2B)
	▼	6.0 - 7.9 Dense, Brown clayey fine SAND, moist, strong chemical odor	FILL		6.0	10.2 & 80.3	G5 & G6	2 IN SS	10-32-10-11	42	1.5 / 2.0	
		7.9 - 8.0 Soft, White-light brown clay-like material (SLUDGE), wet, strong chemical odor	FILL		8.0	70.2	G7	2 IN SS	8-8-8-6	16	1.5 / 2.0	
10		8.0 - 10.0 Soft to firm, white to light brown clay like material (SLUDGE) mixed with medium sand, wet, strong chemical odor	FILL		10.0	85.6	G8 & G9	2 IN SS	2-1-1-3	2	2.0 / 2.0	
		10.0 - 12.0 same as above										
		12.0 - 14.0 Stiff, Brown and tan silty CLAY, wet, strong chemical odor	CL		12.0	34.5 & 30.2	G10 & G11	2 IN SS	6-6-8-9	15	2.0 / 2.0	
15		14.0 - 16.0 Stiff, Brown and tan silty CLAY with trace of fine gravel, wet, strong chemical odor	CL		14.0	17.7	G12	2 IN SS	6-6-10-10	16	2.0 / 2.0	Sieve analysis and Atterberg limits 14 to 16 feet.
		16.0 - 18.0 Stiff, Gray silty CLAY, wet, strong chemical odor	CL		16.0	15.7	G13	2 IN SS	5-8-9-8	17	2.0 / 2.0	
		18.0 - 19.0 same as above	CL		18.0	20.2 & 602	G14 & G15	2 IN SS	5-10-14-11	24	1.5 / 2.0	
20		19.0 - 20.0 Compact, Gray and brown fine to medium SAND, wet, strong chemical odor present, sample coated with brown oil-like material	SP		19.0							
		20.0 - 22.0 Compact, Gray and brown fine to medium SAND, wet, strong chemical odor present, sample coated with brown oil-like material	SP		20.0	2000	G16	2 IN SS	5-7-10-11	17	2.0 / 2.0	
		Boring completed at 22.0 ft										
25												
30												
35												
40												

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER: Jim Bucksar

GA INSPECTOR: NPM
CHECKED BY: AH
DATE: 9/26/11

AA BOREHOLE RECORD NO WELL H8A BORING8_G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-10_G03

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME LC-55
DATE STARTED: 11/2/10
DATE COMPLETED: 11/2/10
WEATHER: Sunny

DATUM: Site
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 50 F

INCLINATION: -90
DEPTH W.L.: 4.5 ft
ELEVATION W.L.:
DATE W.L.: 11/2/10
TIME W.L.: 11:00 am

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
0		0.0 - 0.3 Loose, Dark brown clayey fine SAND with some organics (plant roots), moist, mild chemical odor	TOPSOIL		0.3	0 & 0	G1 & G2	3 IN SS	3 -7 -13 -12	20	2.0 / 2.0	Sieve analysis and Atterberg limits 0 to 5 feet. (See boring log SB-10_G03B).
		0.3 - 2.0 Compact, Dark brown clayey fine SAND with trace of fine gravel and some organics (plant roots), dry, strong chemical odor	FILL		2.0	519 & 700	G3 & G4	3 IN SS	10 -10 -12 -11	22	2.0 / 2.0	
		2.0 - 3.2 Compact, Dark brown clayey fine SAND, moist, strong chemical odor	FILL		3.2	910	G5	3 IN SS	1 -3 -5 -5	8	2.0 / 2.0	Sieve analysis, Atterberg limits and Permeability test 5 to 7 feet (See boring log SB-10_G03B). K=4.07x10^{-4} cm/sec
5		3.2 - 4.0 same as above	FILL		4.0							
		4.0 - 6.0 Firm, Dark brown silty CLAY with little organics (plant roots), moist, strong chemical odor	FILL		6.3	138 & 200	G6 & G7	3 IN SS	6 -5 -4 -3	9	2.0 / 2.0	
		6.0 - 6.3 same as above	SLUDGE		6.0							
		6.3 - 8.0 Very soft, White clay-like material (SLUDGE), wet, strong chemical odor	CL		8.5	137 & 159.3	G8 & G8A	3 IN SS	1 -2 -11 -11	13	2.0 / 2.0	Sieve analysis, Atterberg limits and Permeability test 10 to 12 feet (See boring log SB-10_G03B). K=1.35x10^{-7} cm/sec
10		8.0 - 8.5 Stiff, Brown silty CLAY, moist, strong chemical odor	CL		10.0	155.7	G9	3 IN SS	2 -7 -9 -11	16	2.0 / 2.0	
		8.5 - 10.0 Stiff, Brown silty CLAY with trace of fine gravel, moist, strong chemical odor	CL		12.0	92.2 & 56.8 & 51.2	G10, G11 & G12	3 IN SS	11 -20 -19 -16	39	2.0 / 2.0	
		10.0 - 12.0 Stiff, Brown silty CLAY with some fine gravel, moist, mild chemical odor	SM		13.0							
		12.0 - 13.0 same as above	SM		13.5							
15		13.0 - 13.5 Dense, Brown fine SAND, wet, mild chemical odor	SM		14.0	48.7 & 15.8	G13 & G14	3 IN SS	10 -75/3	>50	2.0 / 2.0	
		13.5 - 14.0 Dense, Brown fine SAND with some fine gravel, wet, mild chemical odor	Weathered Rock		15.5							
		14.0 - 15.5 same as above										
		15.5 - 16.0 Gray and tan weathered SHALE rock, wet, mild chemical odor										
		Boring completed at 16.0 ft										
20												
25												
30												
35												
40												

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER: Jim Bucksar

GA INSPECTOR: NPM
CHECKED BY: AH
DATE: 9/26/11

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G06 TO G15.GPJ GOLDER.NJ.PA.05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-10_G03B

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-8154
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME LC-55
DATE STARTED: 11/2/10
DATE COMPLETED: 11/2/10
WEATHER: Sunny

DATUM: Site
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 50 F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		TOPSOIL			0.3					
		FILL					G1	BULK	5.0 / 5.0	
5							G2	SH	0.9 / 2.0	
		SLUDGE			6.3					
		CL			8.0		G3	BULK	1.0 / 1.0	
10							G4	SH	1.9 / 2.0	
							G5	BULK	1.0 / 1.0	
		SM			13.0					
15		Weathered Rock			15.5					
20										
25										
30										
35										
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER: Jim Bucksar

GA INSPECTOR: NPM
CHECKED BY: AH
DATE: 9/26/11

AA BOREHOLE RECORD NO WELL HSA BORINGS G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

BOREHOLE LOG: RW11-51 (GW-11-02)

PROJECT: Rutgers Organic Corp.
PROJECT NO.: 933-6154.005
HOLE DEPTH: 21.5
DEPTH OF SOIL DRILL: 21.5
DEPTH OF ROCK CORE: 0
AZIMUTH: N/A PLUNGE:-90

BOREHOLE LOCATION: Salem, OH
COORDINATES: N: N/A E: N/A
GROUND SURFACE ELEV.: N/A
DATUM: G.S.
START DATE/TIME: 1/31/2011 / 9:32:00 AM
END DATE/TIME: 1/31/2011 / 11:25:00 AM

DRILLING METHOD: Geoprob then 3.5 HSA
CORING METHOD: N/A
DRILL RIG: Geoprobe

Depth Elev.	LITHOLOGY DESCRIPTION	Graphical Log	SAMPLE INFORMAITON: Sample No. or Run No.	Type	Blows per Foot	N Value	PID (ppm)	Soil Rec./Att. or Core Rec. %	Soil Sample Description	Well Graphic	Well Construction Information
0	0-4 ft-bgs: Topsoil		P1	Geo Probe		N/A	0	12 / 48	0.0 to 4.0 ft-bgs: Dark brown, Silty fine SAND, with some silt (non-plastic) and little orgnics, no odor, damp. [SM]		3.1 ft stainless steel stickup.
											0.1 to 1.0 ft-bgs: Backfill
	4-13.5 ft-bgs: Fill (Silty Sand)		P2	Geo Probe		N/A	0	42 / 48	4.0 to 8.0 ft-bgs: Brown gray, Silty fine SAND, with some silt (non-plastic), no odor, moist to wet. [SM] - bottom 0.5 ft of sample is wet.		
5											
			P3 / SA1	Geo Probe / Tube		N/A	3.4	48 / 48	8.0 to 12.0 ft-bgs: Gray, Silty fine SAND to Clayey Silt, some to and Silty Clay, strong odor, wet. [SM] - staining/sheen from 10 to 10.5 ft-bgs. - Shelby tube pushed from 8 to 10 ft-bgs (the tube was driven twice over the same interval (the first time, the sample fell out because the material was too loose/wet.)		1.0 to 14.5 ft-bgs: Bentonite seal.
10											
			P4 / SA2	Geo Probe / Tube		N/A	3	48 / 48	12.0 to 13.5 ft-bgs: Gray, Silty fine SAND to Clayey Silt, some to and Silty Clay, strong odor, wet. [SM] 13.5 to 16.o ft-bgs: Stiff, brown, Silty CLAY (low to moderate plasticity), no odor, wet. [CL] - Shelby tube pushed from 15 to 16 ft-bgs.		
15	13.5-20 ft-bgs: Stiff Clay (Sieve Analysis and Permeability test 15 to 16 feet, k=3.8 x 10^{-8} cm/sec) (Sieve Analysis 15 to 20 feet)										14.5 to 21.5 ft-bgs: Filter sand (#5 silica sand)
			P5 / SA3	Geo Probe		N/A	0	48 / 48	16.0 to 20.0 ft-bgs: Stiff, gray to grayish-brown, Silty CLAY (low to moderate plasticity), no odor, wet. [CL]		
20	20-21.5 ft-bgs: Sandy Silt (Sieve Analysis 20 to 22 feet)		P6 / SA4	Geo Probe		N/A	34	18 / 18	20.0 to 21.5 ft-bgs: Gray, Silty fine SAND, some silt (low plasticity), strong odor, wet. [SM]		16.5 to 21.5 ft-bgs: Slotted 2-inch diameter stainless steel screen
25											

DRILLING COMPANY: Frontz Drilling
DRILLER: Jeremy L.

GOLDER INSPECTOR: Joshua Nasrallah

LOGGED BY: Joshua Nasrallah
LOGGED BY DATE: 9/23/2011
CHECKED BY: AH
CHECKED BY DATE: 9/26/2011

Golder Associates

RECORD OF BOREHOLE SB-12-G06

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 13.5 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,202.4 E: 2,444,781.9
GS ELEVATION: 1186.2 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1185	0.0 - 1.0 TOPSOIL; fill with slag fragments			1185.2					
		1.0 - 4.0 Brown clayey SILT, some fine grained sand, little fine gravel			1.0	55.7		MACRO CORE	3.0 / 4.0	
5	1180	4.0 - 8.0 Yellowish brown clayey SILT, some fine grained sand, little fine gravel			1182.2 4.0	34.3		MACRO CORE	2.7 / 4.0	Wood fragments at 6.0'
10	1175	8.0 - 12.5 Brownish yellow clayey SILT, some fine grained sand, little fine gravel			1178.2 8.0	222.7		MACRO CORE	3.7 / 4.0	
		12.5 - 13.5 Weathered SHALE			1173.7 12.5	129.6		MACRO CORE	1.5 / 1.5	Refusal at 13.5'
15	1170	Boring completed at 13.5 ft			1172.7					
20	1165									
25	1160									
30	1155									
35	1150									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G07

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 19.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,199.6 E: 2,444,691.9
GS ELEVATION: 1189.4 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 4.0 Dark grayish brown CLAY with some coarse grained sand, slag fragments, moist			1185.4	2.4		MACRO CORE	3.5 / 4.0	
5	1185	4.0 - 6.0 Dark gray CLAY with some coarse grained sand, little gravel, slag fragments, moist			4.0 1183.4	150		MACRO CORE	3.0 / 4.0	
		6.0 - 10.5 Dark gray clayey SILT, moist			6.0					
10	1180				1178.9	1324		MACRO CORE	4.0 / 4.0	Oily sheen at 9'
		10.5 - 13.0 Brown silty SAND, some fine to coarse gravel			10.5 1176.4					
		13.0 - 14.0 Gray SHALE fragments			13.0 1175.4	1530		MACRO CORE	3.5 / 4.0	
15	1175	14.0 - 18.5 Brown clayey SILT, little coarse grained sand			14.0					
					1170.9	2343		MACRO CORE	3.5 / 3.0	
		18.5 - 19.0 Dark gray silty SAND, little fine gravel, moist			1170.4					Refusal at 19.0'
20	1170	Boring completed at 19.0 ft								
25	1165									
30	1160									
35	1155									
40	1150									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G08 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G08

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 12.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,271.8 E: 2,444,752.9
GS ELEVATION: 1185.6 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1185	0.0 - 0.5 TOPSOIL with roots			1185.1 0.5					
		0.5 - 8.0 Very dark grayish brown clayey SILT, little coarse grained sand, little fine gravel				228.1		MACRO CORE	3.5 / 4.0	Soft soil 3.0'-12.0'
5	1180					383.6		MACRO CORE	4.0 / 4.0	
					1177.6 8.0					
		8.0 - 12.0 Pale yellow clayey SILT, little coarse grained sand, little fine gravel, moist				1404		MACRO CORE	4.0 / 4.0	
10	1175				1173.6					Refusal at 12.0'
		Boring completed at 12.0 ft								
15	1170									
20	1165									
25	1160									
30	1155									
35	1150									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G09

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,311.6 E: 2,444,704.5
GS ELEVATION: 1185.8 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1185	0.0 - 0.5 TOPSOIL with roots and grass			1185.3 0.5					
		0.5 - 4.8 Very dark grayish brown clayey SILT with little coarse sand, little gravel, strong odor				155.5		MACRO CORE	4.0/4.0	
5	1180	4.8 - 8.5 White SLUDGE			1181.0 4.8	1803		MACRO CORE	4.0/4.0	Oily staining at 6'
		8.5 - 10.0 Brownish yellow stained clayey SILT, little coarse sand, little gravel, strong odor			1177.3 8.5					
10	1175	10.0 - 15.7 Brown stained clayey SILT, little coarse sand, little gravel, strong odor			1175.8 10.0	1142		MACRO CORE	4.0/4.0	
						2735		MACRO CORE	4.0/4.0	
15	1170				1170.1					Oily staining at 15'
		15.7 - 16.0 Brown silty SAND								Refusal at 16.0'
		Boring completed at 16.0 ft								
20	1165									
25	1160									
30	1155									
35	1150									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS G02 TO G05, G08 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G10

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 12.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/9/12
DATE COMPLETED: 1/9/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,353.5 E: 2,444,669.1
GS ELEVATION: 1186.1 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1185	0.0 - 0.5 TOPSOIIL			1186.6 0.5					Temporary well installed, 5.0' screen from 4.0' to 9.0'
		0.5 - 2.0 Brown clayey SILT, little coase grained sand, trace gravel, non-plastic, wood fragments			1184.1 2.0	783		MACRO CORE	4.0/4.0	
		2.0 - 4.0 Brown silty fine grained SAND, strong odor			1182.1					Water level 3.72' on 1/10/12 07:35
5	1180	4.0 - 10.0 White clayey SAND, little fine gravel, strong odor			4.0	59		MACRO CORE	4.0/4.0	Oily staining from 4' to 10'
10	1175	10.0 - 12.0 Brown clayey SILT			1176.1 10.0	337		MACRO CORE	4.0/4.0	
		Boring completed at 12.0 ft			1174.1					Refusal at 12.0'
15	1170									
20	1165									
25	1160									
30	1155									
35	1150									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G08 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G11

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 13.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,438.6 E: 2,444,674.6
GS ELEVATION: 1184.7 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 1.0 Dark brown TOPSOIL and roots			1183.7 1.0					
		1.0 - 4.0 Dark brown clayey SILT, little coarse sand, little fine gravel, moist				2.1		MACRO CORE	4.0 / 4.0	Slight odor at 2.0'
					1180.7 4.0					
5	1180	4.0 - 5.0 White SLUDGE			1179.7 5.0					
		5.0 - 8.0 Yellow clayey SILT, some coarse sand, little fine gravel				12.9		MACRO CORE	4.0 / 4.0	
					1176.7 8.0					Discrete sample D(8.0'-9.2')
		8.0 - 9.2 Grayish brown silty fine to coarse grained SAND			1175.5 9.2					
10	1175	9.2 - 13.0 Grayish brown clayey SILT, some coarse sand, little fine gravel				24.6		MACRO CORE	4.0 / 4.0	
										Moist 12.0'-13.0'
					1171.7	3		MACRO CORE	1.0 / 1.0	Refusal at 13.0'
		Boring completed at 13.0 ft								
15	1170									
20	1165									
25	1160									
30	1155									
35	1150									
40	1145									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G08 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G12

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 22.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/9/12
DATE COMPLETED: 1/9/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,243.9 E: 2,444,570.0
GS ELEVATION: 1194.3 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 4.0 Dark brown CLAY with sand, rock fragments, fill, moist			1190.3 4.0	0.7		MACRO CORE	4.0/4.0	
5	1190	4.0 - 18.5 Brown clayey SILT, little coarse grained sand, trace fine gravel, non-plastic, moist				0.8		MACRO CORE	4.0/4.0	
10	1185					0.1		MACRO CORE	4.0/4.0	
15	1180					0.1		MACRO CORE	4.0/4.0	Soil becomes more plastic at 14.5'
20	1175	18.5 - 18.7 Gray fine grained SAND			1175.8 18.7	0.1		MACRO CORE	3.5/4.0	
		18.7 - 20.0 Gray SILT, little coarse grained sand, trace fine gravel, non-plastic, moist			1174.3 20.0					Discrete sample D(20.0'-21.2')
		20.0 - 22.0 Brown coarse grained SAND and fine gravel, well graded, wet			1172.3	2.6		MACRO CORE	2.0/2.0	Refusal at 22.0'
		Boring completed at 22.0 ft								
25	1170									
30	1165									
35	1160									
40	1155									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS G02 TO G05, G08 TO G15.GPJ GOLDER-NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G13

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 16.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/9/12
DATE COMPLETED: 1/9/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,331.7 E: 2,444,724.8
GS ELEVATION: 1184.4 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0		0.0 - 0.5 Brown TOPSOIL			1183.9 0.5					
		0.5 - 4.0 Brown clayey SILT, little coarse grained sand, trace gravel, non plastic, moist, trace odor			1180.4	695		MACRO CORE	4.0/4.0	Temporary well set at 8.0' with 5.0' screen Water level 3.10' on 1/10/12 07:40
5	1180	4.0 - 4.5 White clay-like substance, greasy			1179.9 4.5					Oily staining and sheen from 4.5' to 8.0'
		4.5 - 8.0 White clayey SAND, little fine gravel, strong odor			1176.4	1294		MACRO CORE	4.0/4.0	
10	1175	8.0 - 16.0 Yellowish brown clayey SILT, little coarse grained sand, non plastic, trace gravel			8.0	2223		MACRO CORE	4.0/4.0	
	1170					842		MACRO CORE	4.0/4.0	
15					1168.4					Refusal at 16.0'
		Boring completed at 16.0 ft								
20	1165									
25	1160									
30	1155									
35	1150									
40	1145									

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G08 TO G15.GPJ GOLDER.NJ.PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G14

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 19.0 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/9/12
DATE COMPLETED: 1/9/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,201.2 E: 2,444,601.0
GS ELEVATION: 1191.8 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1190	0.0 - 2.0 Very dark grayish brown SAND and gravel fill, moist			1189.8	94.6		MACRO CORE	4.0 / 4.0	
		2.0 - 4.0 Very dark grayish brown clayey SILT, little coarse grained sand, non plastic, some organic fragments and wood			2.0 1187.8					
5	1185	4.0 - 8.0 Dark yellowish brown, silty fine grained SAND, some coarse grained sand, some gravel, moist			4.0 1183.8	650.4		MACRO CORE	4.0 / 4.0	Strong odor at 6.0'
10	1180	8.0 - 12.0 Dark yellowish brown clayey SILT, little coarse grained sand, trace fine gravel, non plastic, moist, strong odor			8.0 1179.8	1100		MACRO CORE	4.0 / 4.0	Oily staining at 10.0'
		12.0 - 14.0 Gray clayey SILT, little coarse grained sand, trace fine gravel, non plastic, strong odor			12.0 1177.8	488		MACRO CORE	4.0 / 4.0	
15		14.0 - 16.0 Gray silty SAND, trace coarse grained sand			14.0 1175.8					
	1175	16.0 - 19.0 Brown coarse grained SAND and fine gravel, well graded, wet			16.0 1172.8	3583		MACRO CORE	1.0 / 3.0	Discrete sample D(18.4'-19.0') Refusal at 19.0'
20		Boring completed at 19.0 ft								
	1170									
25										
	1165									
30										
	1160									
35										
	1155									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

RECORD OF BOREHOLE SB-12-G15

SHEET 1 of 1

PROJECT: ROC Salem, OH
PROJECT NUMBER: 933-6154
DRILLED DEPTH: 17.5 ft
AZIMUTH: N/A
LOCATION: Salem, OH

DRILL METHOD: Macro-core
DRILL RIG: 6620DT
DATE STARTED: 1/10/12
DATE COMPLETED: 1/10/12
WEATHER: Sunny

DATUM: Site
COORDS: N: 459,229.8 E: 2,444,842.9
GS ELEVATION: 1185.5 ft
TOC ELEVATION: NA
TEMPERATURE: 45°F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	REC / ATT	Sample Notes
0	1185	0.0 - 4.0 Dark brown clayey SAND, little coarse sand, little fine gravel, moist, sandstone fragment at 1.5'			1181.5	25		MACRO CORE	3.7 / 4.0	Temporary well set at 12.0' with 5.0' screen
		4.0 - 4.5 White SLUDGE			1181.0 4.5					
5	1180	4.5 - 8.0 Grayish brown clayey SILT, little coarse sand, little fine gravel			1177.5	3448		MACRO CORE	NA / 4.0	Oily staining from 6.0' to 10'
		8.0 - 10.0 Gray SLUDGE, with organic material (roots)			8.0 1175.5					
10	1175	10.0 - 12.0 Gray coarse SAND, little fine gravel			10.0 1173.5	772.5		MACRO CORE	NA / 4.0	
		12.0 - 16.0 Yellowish brown to gray, clayey SILT, some coarse sand, little fine gravel			12.0 1169.5	1470		MACRO CORE	NA / 4.0	
15	1170	16.0 - 17.5 Gray weathered SHALE			16.0 1168.0	1703		MACRO CORE	NA / 1.5	Refusal at 17.5'
		Boring completed at 17.5 ft								
20	1165									
25	1160									
30	1155									
35	1150									
40										

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling Inc.
DRILLER:

GA INSPECTOR: JEB
CHECKED BY: AH
DATE: 9/12/12

AA BOREHOLE RECORD NO WELL HSA BORINGS_G02 TO G05, G06 TO G15.GPJ GOLDER NJ-PA 05-24-06.GDT 9/14/12

LOCATION MAP

ERM—MIDWEST SOIL BORING LOG

BORE NUMBER ▶ SB-17	LOCATION ▶ Salem, Ohio
DATE ▶ 7/01/90	WEATHER ▶ Overcast, Hot
LOGGED BY ▶ RAF	DRILLED BY ▶ Mathes
DRILLING METHOD ▶ 3 1/4" Hollow Stem Auger	SAMPLING METHOD ▶ 3 IN. Split Spoon
ELEVATION ▶ 1189.80 FT.	GROUT ▶ 14.5 - 0 FT.
WATER LEVEL INITIAL ☐ B.G.S. ☐ B.M.P.	HOLE DIA. 6 IN.
WATER LEVEL AT COMPLETION H.M.P.	TOTAL DEPTH 14.5 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm) BZ / HNU	DEPTH	SAMPLE RECOVERY	PENETRATION RESISTANCE	LITHOLOGY / REMARKS	GRAPHIC LOG
						0				
Dry	Poor	Stiff	Slight	1	14 / 14	1	1.7'	Push	FILL: Large gravel rip rap.	
						2			FILL: Brown and orange mottled silty clay, 1 mm white specks	
Dry	Poor	Soft	Non	2	20 / 20	3	2.0'			
					200 / 600	4		Push	FILL: Light gray sludge, black mottles, granular.	
Damp	Poor	Soft	Slight	3	600 / 200	5	2.0'		Same, mixed with brown silty clay.	
					40	6			Brown SILTY CLAY, gravel, trace sand.	
Dry	Poor	Soft	Slight	4	8.5 / 30	7	1.0'		Same as above.	
Dry	Poor	Stiff	Plast.	5	110 / 180				Same, orange mottles.	
Dry	Poor	Stiff	Plast.		84 / 600	8	2.0'		Brown SILTY CLAY, gravel, trace sand.	
Damp	Poor	Stiff	Slight	6	>1000 / 800	9				
						10	1.0'			
Damp	Poor	Stiff	Slight	7	>1000 / 400	11	2.0'		SANDY CLAY and gravel.	
					570 / 600	12				
Wet	Poor	Stiff	Non	8	380 / 400	13	1.0'		CLAYEY SAND and gravel.	
Wet	Mod.	Soft	Non	9	>1000 / 700	14	2.0'		Medium grain SAND and GRAVEL, oily sheen. Grades into sandy clay with sand seams, sand where present has brown oil.	
						15			Total Depth 14.5 FT.	
						16				
						17				
						18				
						19				
						20				

PROJECT\602-01-07\SB-17.DRW

LOCATION MAP

ERM—MIDWEST SOIL BORING LOG

BORE NUMBER ▶ SB-18	LOCATION ▶ Salem, Ohio
DATE ▶ 6/29/90	WEATHER ▶ Warm
LOGGED BY ▶ RAF	DRILLED BY ▶ Mathes
DRILLING METHOD ▶ 3 1/4" Hollow Stem Auger	SAMPLING METHOD ▶ 3 IN. Split Spoon
ELEVATION ▶ 1191.50 FT.	GROUT ▶ 19.5 - 0 FT.
WATER LEVEL INITIAL ☐ B.G.S. ☐ B.M.P.	HOLE DIA. 6 IN.
WATER LEVEL AT COMPLETION H.M.P.	TOTAL DEPTH 19.5 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm) Flow	DEPTH	SAMPLE RECOVERY	PENETRATION RESISTANCE	LITHOLOGY / REMARKS	GRAPHIC LOG
						0		PUSH		
Dry	Poor	Soft	Slight	1	0/0	1	2.0'		Fill: Brown silty clay, gravel, trace sand.	
					0/0	2			Grades to sandy clay at 2.5 FT.	
Dry	Poor	Soft	Slight	2	0/0	3	1.0'			
					0/0			PUSH		
Damp	Poor	Soft	Slight	3	0/0	4	1.75'		Same as above.	
					0/0	5			Same as above.	
				4	92/1		1.0'			
					8/4	6				
Damp	Poor	Soft	Slight	5	16/14	7	1.8'		Same, but with black staining.	
Damp	Poor	Soft	Slight	6	360/30	8	1.0'		Same as above.	
					560/400	9				
Dry	Poor	Hard	Slight	7	>1000/700	10	1.8'		Same to 11.75 FT. sandstone clast at 11.0 FT.	
					16/12	11			FILL: Dark gray silty clay with gravel, trace sand.	
				8	8/5		2.0'			
Dry	Poor	Hard	Non	9	5/3	12			Dark gray SILTY CLAY with gravel, trace sand.	
Wet	Poor	Soft	Non	10	-/-	13	0.08'			
					0.5/1	14			Fine SAND, gravel, shale fragments.	
Wet	Well	Soft	Non	11	0/1	15	1.5'		Fine SAND.	
						16	1.0'			
Wet	Well	Soft	Non	12	0/1	17				
					0/1	18	1.0'			
Damp	Poor	Soft	Non	13		19	1.2'		Gray SILTY CLAY.	
						20			Gray weathered SHALE Total Depth 19.5 FT.	

LOCATION MAP

ERM—MIDWEST SOIL BORING LOG

BORE NUMBER ▶ SB-19	LOCATION ▶ Salem, Ohio		
DATE ▶ 6/27/90	WEATHER ▶ Hot, Clear		
LOGGED BY ▶ RAF	DRILLED BY ▶ Mathes		
DRILLING METHOD ▶ 2 1/4" Hollow Stem Auger	SAMPLING METHOD ▶ 2 IN. Split Spoon		
ELEVATION ▶ 1186.50 FT.	GROUT ▶ 17.5 - 0 FT.		
	WATER LEVEL INITIAL	☐ B.G.S. ☐ B.M.P.	HOLE DIA. 8 IN.
	WATER LEVEL AT COMPLETION	N.M.P.	TOTAL DEPTH 17.5 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm)	SAMPLE RECOVERY	PENETRATION RESISTANCE
Dry	Non	Soft	Non	1	0/0, 10/0	1.7'	Wt., Wt., Wt., Wt.
Dry	Non	Soft	Slight	2	100/82	0.9'	Wt., Wt.
Dry	Non	Soft	Slight	3	92/70	0.7'	Wt., Wt.
Dry	Non	Soft	Slight	4	52/70, 750/>1000	2.0'	
Damp	Non	Soft	Slight	5	42/28, 70/55	2.0'	
Damp	Non	Soft	Slight	6	290/220	1.0'	
Damp	Non	Soft	Non	7	190/180, >1000/280	1.3'	Wt.
Wet	Non	Soft	Non	8	>1000/800	1.0'	
Dry	Non	Hard	Slight	9	>1000/800, >1000/680	1.7'	Push
						1.0'	
Dry	Non	Hard	Slight	10	>1000/820	1.0'	60/6, 100/6
Damp	Poor	Hard	Non	11	>1000/780	1.25'	21, 113, 170

DEPTH (FT.)	LITHOLOGY / REMARKS
0	Brown TOPSOIL, grass, roots.
0.5	FILL: Brown and black silty clay, gravel.
2	Same as above.
3	Same as above.
4	Same as above.
6.5	Damp at 6.5 FT. Same as above.
8	FILL: Brown SILTY CLAY, gravel, sheen on soil.
10	FILL: Brown and yellow sludge, oily sheen on sludge, gravel mixed with sludge at 12 FT.
12	Brown fine SAND, silty clay.
13	Brown SILTY CLAY, brown oil. Brown SILTY CLAY mixed with fine grained sand.
15	Same as above, with oily sheen.
16	Dark brown CLAY SAND and gravel, oil present.
17.5	Brown-gray SHALE, shale pieces in tip of spoon. Total Depth 17.5 FT.

GRAPHIC LOG

PROJECT/1202-01-07/SB-19.DRW

LOCATION MAP

ERM–MIDWEST SOIL BORING LOG

BORE NUMBER ▶ SB-20	LOCATION ▶ Salem, Ohio
DATE ▶ 6/27/90	WEATHER ▶ Warm
LOGGED BY ▶ RAF	DRILLED BY ▶ Mathes
DRILLING METHOD ▶ 3 1/4" Hollow Stem Auger	SAMPLING METHOD ▶ 3 IN. Split Spoon
ELEVATION ▶ 1185.00 FT.	GROUT ▶ 17.0 - 0 FT.
WATER LEVEL INITIAL ☐ B.G.S. ☐ B.M.P.	HOLE DIA. 6 IN.
WATER LEVEL AT COMPLETION B.M.P.	TOTAL DEPTH 17.0 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm) Hnu	DEPTH	SAMPLE RECOVERY	PENETRATION RESISTANCE	LITHOLOGY / REMARKS	GRAPHIC LOG
						0				
Dry	Poor	Soft	Slight	1	46 / 2 / 32 / 17.5	1	1.7'	Push	FILL: Brown silty clay with gravel, roots.	
Dry	Poor	Soft	Slight	2	730 / 200	2	0.9'	Push	FILL: Gray silty clay with gravel, sand and black staining.	
Dry	Poor	Soft	Slight	3	200 / 200 / 98 / 19	3			Same as above.	
Damp	Poor	Soft	Slight	4	74 / 8.5	4	0.7'	Push		
Damp	Poor	Soft	Slight	5	48 / 11.5 / 400 / 150	5	2.0'	Push	Same as above.	
Wet	Poor	Soft	Slight	6	>1000 / 200	6				
Wet	Poor	Soft	Slight	7	>1000 / 200 / >1000 / 200	7	2.0'	Push	Same, brown oil at 7.5 FT.	
Dry	Poor	Hard	Non	8	200 / 200	8	1.0'	Push	FILL: Light tan granular sludge, interbedded layers of pure sludge, granular and gray at 9.0 FT., brown oil in sludge.	
Damp	Poor	Hard	Slight	9	>1000 / 200	9				
Damp	Poor	Hard	Slight	10	>1000 / 200 / >1000 / 80	10	1.2'	Push	FILL: Granular material, dry.	
						11	1.0'		Brown SILTY CLAY with gravel, oil, sand.	
						12			Same as above.	
						13	2.0'		3 IN. SAND at layer at 13.5 FT.	
						14		99	Same as above.	
						15	2.0'			
						16			SAND.	
Wet	Poor	Hard	Non	11	>1000 / 400	17	1.0'		SANDY CLAY with gravel, silt at 16.5 FT.	
						18			Spoon refusal, SHALE bedrock. Total Depth 17.0 FT.	
						19				
						20				

PROJECT/202-01A-07/SB-20.DRW

J-202-01-07

LOCATION MAP

ERM—MIDWEST SOIL BORING LOG

Page 1 of 1

BORE NUMBER ▸ SB-21	LOCATION ▸ Salem, Ohio
DATE ▸ 6/28/90	WEATHER ▸ Hot, Humid
LOGGED BY ▸ RAF	DRILLED BY ▸ Mathes
DRILLING METHOD ▸ 3 1/4" Hollow Stem Auger	SAMPLING METHOD ▸ 3 IN. Split Spoon
ELEVATION ▸ 1183.40 FT.	GROUT ▸ 16.5 - 0 FT.
WATER LEVEL INITIAL ☐ B.G.S. ☐ B.M.P.	HOLE DIA. 6 IN.
WATER LEVEL AT COMPLETION N.M.P.	TOTAL DEPTH 16.5 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm) Hnu	DEPTH	SAMPLE RECOVERY	PENETRATION RESISTANCE	LITHOLOGY / REMARKS	GRAPHIC LOG
Dry	Poor	Soft	Non	1	16 / -	0–1	2.0'	Push	FILL: Light to dark brown silty clay, gravel, roots,trace sand.	
Dry	Poor	Soft	Slight	2	12 / -	1–3	1.0'		Same as above.	
Dry	-	-	-	3	16 / 16	3–4	2.0'		Same as above.	
Wet	-	-	-	4	20 / 20	5	1.0'		FILL: Light tan bedded sludge, oily sheen.	
Wet	-	-	-	5	10 / 14	6–7	1.5'		FILL: Light brown silty clay, dry.	
Wet	-	-	-	6	14 / 14	8–9	1.0'		FILL: Light tan sludge, oily sheen, cream sludge.	
Dry	Poor	Soft	Non	7	800 / 160	10	2.0'		Becomes gray granular sludge, damp.	
Dry	Poor	Soft	Non	8	400 / 800	11–12	1.0'	10	FILL: Tan sludge.	
				9	16 / 4	13	1.75'		FILL: Granular sludge.	
Damp	Poor			10	40 / 20	14–15	1.0'		Dark gray SILTY CLAY, gravel, trace sand, oily sheen.	
Damp	Poor			11	400 / 70	16	1.25'		Same, oily sheen.	
					>1000 / 320	17–20			Gray SILTY SAND, silt, oily sheen.	
									SAND and GRAVEL, shale fragments, wood fragments.	
									Gray SHALE, fissile, bedding plane breaks. Total Depth 17.0 FT.	

PROJECT2002-01A-07/90-21.DRW

J-002-01-07

LOCATION MAP

ERM—MIDWEST SOIL BORING LOG

Page 1 of 1

BORE NUMBER ▶ SB-31	LOCATION ▶ Salem, Ohio
DATE ▶ 7/10/90	WEATHER ▶ Overcast, Humid
LOGGED BY ▶ RAF	DRILLED BY ▶ Mathes
DRILLING METHOD ▶ 3 1/4" Hollow Stem Auger	SAMPLING METHOD ▶ Shelby Tube
ELEVATION ▶ 1184.60 FT.	GROUT ▶ 16 - 0 FT.
WATER LEVEL INITIAL ☐ B.G.S. ☐ B.M.P.	HOLE DIA. 6 IN.
WATER LEVEL AT COMPLETION H.M.P.	TOTAL DEPTH 16 FT.

MOISTURE CONTENT	SORTING	DENSITY	PLASTICITY	SAMPLE NO.	OVA (ppm) Flame / Hnu	DEPTH	SAMPLE RECOVERY	PENETRATION RESISTANCE	LITHOLOGY / REMARKS	GRAPHIC LOG
				1	2000 / 80	0		ST	FILL: Brown silt.	
						1	3.5'	ST		
						2		ST		
								ST	FILL: Gray silty clay and tan sludge.	
						3		ST		
								ST	FILL: Tan sludge.	
Damp	-	-	-	2	>1000 / 150	4	0.25'	ST		
								ST		
						5		ST		
Wet								ST	Sludge too wet to stay in shelby tube.	
						6	0	ST		
								ST		
						7		ST		
								ST	Sludge too wet to stay in shelby tube.	
						8	0	ST		
								ST		
						9		ST		
								ST		
				3	>1000 / 480	10	2.0'	ST	Brown SILTY CLAY with oil, gravel.	
								ST		
						11		ST		
								ST	Gray SILTY CLAY.	
				4		12	1.5'	ST		
								ST		
						13		ST		
								ST	Same as above.	
				5		14	1.5'	ST		
								ST		
						15		ST		
								ST	Same as above.	
						16	1.0'	ST		
									Refusal, Total Depth 16.0 FT.	
						17				
						18				
						19				
						20				

PROJECT2302-01-GRSB-31.DRW

J-302-01-07

Well #S18

Coordinates: 1102, E95
Ground Surface Elevation: 1188.55'

Geologic Log:

Cover		
0.0 -	1.0'	Dry, brown clay loam.
1.0 -	2.5'	Moist, brown clay loam. Buried soil horizon at 2.5 feet consisting of poorly decomposed grass and root zone.
Pond Material		
2.5 -	3.0'	Moist, soft sandy clay.
3.0 -	4.0'	Gray-brown sandy clay silt. Chemical odor. Decomposed organic material at 4 feet, may be buried soil horizon.
4.0 -	7.5'	White crystalline sludge interlayered with gray-brown sandy clay silt. Strong chemical odor. Water below 5 feet. Brown oil is mixed with water.
7.5 -	11.0'	Moist hard, gray sandy sludge. Below 10 feet is gravelly, mixed with small amounts of red sand.
11.0 -	11.5'	Moist bright yellow sandy sludge. Sharp boundary at 11 feet.
11.5 -	12.0'	Grades downward into moist yellow-brown sandy clay.
12.0 -	13.5'	Wet gray sandy sludge.
Till		
13.5 -	14.0'	Hard gray and brown clay. Sharp boundary at 13.5 feet, may be bottom of pond.
14.0 -	15.5'	Interlayers of wet brown sand, wet brown silty sand, and hard brown clayey sand. Gravelly.
15.5 -	16.0'	Hard, blue-gray, gravelly silty clay. Contains small shale fragments.
16.0 -	17.0'	Wet, brown gravelly silty sand. Sheen of bluish oil.
Bedrock		
17.0 -	20.0'	Soft, highly weathered gray shale.

Specifications:

2 Inch Casing
- Type of casing: steel
- Top of casing elevation: 1,190.42 feet above ground surface
- Length of casing above ground surface: 1.92 feet
- Casing depth: 13 feet below ground surface

Borehole
- Depth: 20 feet below ground surface
- Drilling contractor: Layne-Ohio

Screen
- Type: Johnson No. 10 stainless steel, 2" x 5'
- Setting: 13 to 18 feet below ground surface

Sand pack
- Type: Coarse masonry sand
- Setting: 12 to 20 feet below ground surface

Grout
- Type: Bentonite-Portland cement
- Setting: 0 to 11 feet below ground surface

SOUTHERN SHALLOW GROUNDWATER AREA GEOTECHNICAL BORING AND MONITORING WELL INSTALLATION LOGS

RECORD OF BOREHOLE SB12-G61

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 45.1 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/12/12
DATE COMPLETED: 7/13/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,560.9 E: 2,444,452.8
GS ELEVATION: 1197.7 ft
TOC ELEVATION:
TEMPERATURE: 70's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
0		0.0 - 0.7 OL - Organic SILT, organics, dark brown, no odor; dry, loose.	OL		1197.0	0						
			ML		0.7 1196.7	0	1	SS	4-9-11-12	20	1.5/2.0	
	1195	0.7 - 2.0 ML - SILT; some angular gravel; tan, no odor; dry, loose.	ML		2.0 1194.1	0	2	SS	12-17-15-15	32	2.0/2.0	
		2.0 - 3.6 ML - SILT; some angular gravel; tan-brown mottling; no odor; dry, compact.	ML		4.0 1191.7	0	3	SS	6-5-6-8	11	1.7/2.0	
5		3.6 - 4.0 ML - sandy SILT, fine to coarse sand, some fine angular gravel; dark brown, iron cementation 3.9-4 ft bgs, no odor; dry, compact.	ML		6.0 1189.2	0	4	SS	8-7-10-9	17	1.0/2.0	
	1190	4.0 - 6.0 ML - CLAYEY SILT; trace fine angular to subangular gravel; brown, no odor; cohesive, moist, firm (5.1-6 ft bgs: sandy CLAYEY SILT, fine sand).	CL ML SM CL		1188.7 1188.2 1187.4 10.3	0 0 0 0.1	5 6	SS SS	8-12-11-7 2-2-5-9	23 7	1.8/2.0 1.4/2.0	
10		6.0 - 8.5 ML - CLAYEY SILT, some coarse subrounded to subangular gravel, brown, iron staining, no odor; cohesive, moist, firm.	SM CL CL		1185.7 1185.0	0 0	7	SS	3-5-8-7	13	1.8/2.0	
	1185	8.5 - 9.0 CL - SILTY CLAY; some fine subrounded gravel; grey, no odor; moist, firm.	ML SM ML		14.0 1181.7	0 0 0	8	SH	N/A	N/A	1.9/2.0	
15		9.0 - 9.5 ML - CLAYEY SILT; some fine subrounded to subangular gravel; brown, no odor; moist, stiff.	CL		16.0 1179.7	N/A 0	9	SS	2-4-3-5	7	1.5/2.0	
	1180	9.5 - 10.3 SM -SILTY SAND, fine to coarse sand; some fine subangular gravel; brown, no odor; wet, loose.	CL		18.0 1177.7	0 N/A	10	SH	N/A	N/A	1.9/2.0	
20		10.3 - 12.0 CL - sandy SILTY CLAY, fine sand; trace subangular gravel; brown, 0.25-inch iron bands at 10.1 and 10.25 f bgs, no odor; cohesive, very moist to wet, soft to firm.	CL		20.0 1173.7	0 0.1 0.1 0 0.1 0.1 0.1 0.1	11 12	SS SS	4-7-9-9 12-12-14-9	16 26	1.5/2.0 2.0/2.0	
	1175	12.0 - 12.8 SM - SILTY SAND, fine to coarse sand; some subangular to angular gravel; brown, no odor; wet, loose.	CL		24.0 1171.2	0.2 0.2 0.2 0.2	13	SS	3-6-5-9	11	1.2/2.0	
25		12.8 - 12.9 CL - SILTY CLAY; trace fine to coarse sand; brown, no odor; moist, firm.	ML SM SM		27.4 1169.1	0.1 0.1 0.1	14	SS	10-12-12-28	24	2.0/2.0	
	1170	12.9 - 13.3 CL - SILTY CLAY; trace coarse subangular gravel; grey, no odor; moist, firm.	SM-GP		28.6	0.1	15	SS	3-3-7-6	10	1.0/2.0	
30		13.3 - 13.6 ML - SILT; trace coarse subrounded to subangular gravel; brown, no odor; moist, loose.	CL		1165.7	0 0.1 0.1 0.1 0.1	16	SS	2-3-4-7	7	0.6/2.0	
	1165	13.6 - 14.0 SM - SILTY SAND, fine to coarse sand; some subangular to angular gravel; brown, no odor; wet, loose.	SM-GP		32.0 1163.7	0.2 0.2	17	SS	7-10-15-20	25	1.3/2.0	
		14.0 - 16.0 Shelby Tube pushed 14-16 ft bgs (SILT)										
35		16.0 - 18.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft (16.8 ft bgs: 1-inch SILTY SAND seam, fine sand, brown, no odor; very moist to wet, loose).	CL		34.0 1161.3	0.1 0.1 0.1 0.1	18	SS	8-14-7-9	21	1.7/2.0	
	1160	18.0 - 20.0 Shelby Tube pushed 18-20 ft bgs (SILTY CLAY).	SM CL SM CL		37.0 1159.7 38.0	0.1 0.1 0.1	19	SS	11-10-14-11	24	2.0/2.0	
		20.0 - 24.0 CL - SILTY CLAY; some fine subangular to angular gravel; grey, no odor; moist, firm to stiff (22.2-22.3 ft bgs: wet, soft).	CL		1157.7 40.0	0.1 0.1 0.1 0.1	20	SS	3-5-5-7	10	0.9/2.0	
40		24.0 - 26.5 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; wet, firm (0.2-inch SILTY SAND seams at 24.2, 24.5 and 24.1 ft bgs, fine sand; wet).	CL		1156.7 42.0	0.1 0.1 0.1 0.1	21	SH	N/A	N/A	2.0/2.0	
	1155	26.5 - 26.9 ML - gravelly SILT, fine subangular gravel, grey, no odor; non-cohesive, wet, loose.	GP		1153.0	N/A 0.1 0.1 0.1 0.1	22 23	SS SS	3-5-7-4 5-47-50/1	12 >97	1.6/2.0 1.0/1.1	
45		26.9 - 27.2 SM - SILTY SAND, fine to coarse sand, grey, no odor; wet, loose.				0.1 0.1 0.1						
	1150	27.2 - 27.4 SM - SILTY SAND, fine sand, grey-brown, no odor; wet, compact.										

Log continued on next page

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE SB12-G61

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 45.1 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/12/12
DATE COMPLETED: 7/13/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,560.9 E: 2,444,452.8
GS ELEVATION: 1197.7 ft
TOC ELEVATION:
TEMPERATURE: 70's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
50		27.4 - 28.6 SM-GP, SILTY SAND and GRAVEL, fine to coarse sand, fine to coarse subrounded gravel, grey-brown, no odor; wet, compact (increasing gravel size with depth).										
	1145	28.6 - 32.0 CL - SILTY CLAY; trace fine subangular gravel; grey, no odor; wet, soft to firm.										
55		32.0 - 34.0 SM-GP - SILTY SAND and GRAVEL, fine to coarse sand, fine subangular gravel, grey, no odor; wet, loose to compact (SILTY CLAY lenses at 32.1, 32.3, 32.5 and 32.9 ft bgs).										
	1140	34.0 - 36.4 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; wet, firm (34.75-34.9 ft bgs: SILTY SAND seam, fine to coarse sand, grey-brown, no odor; wet, loose).										
60		36.4 - 36.8 SM - SILTY SAND, fine to coarse sand; some fine subrounded to subangular gravel; brown; moist to wet, compact.										
	1135	36.8 - 36.9 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; wet, stiff.										
65		36.9 - 37.0 SM - SILTY SAND, fine to coarse sand; some fine subrounded to subangular gravel; brown; moist to wet, compact.										
	1130	37.0 - 38.0 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; moist, stiff.										
		38.0 - 40.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; wet, firm.										
70		40.0 - 42.0 Shelby Tube pushed 40-42 ft bgs (SILTY CLAY).										
	1125	42.0 - 44.7 CL - SILTY CLAY; trace fine sand; trace fine subangular to subrounded gravel; grey, no odor; wet, firm.										
75		44.7 - 44.8 GP - weathered siltstone GRAVEL, grey, no odor; moist, soft.										
	1120	44.8 - 45.1 SILTSTONE - crushed siltstone GRAVEL, grey, no odor; dry (Refusal at 45.1 ft bgs).										
		Boring completed at 45.1 ft										
80												
	1115											
85												
	1110											
90												
	1105											
95												
	1100											

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE SB12-G62

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 41.9 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/19/12
DATE COMPLETED: 7/19/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,379.6 E: 244,686.4
GS ELEVATION: 1189.9 ft
TOC ELEVATION:
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
0		0.0 - 4.0 ML - SILT, brown-grey mottling, no odor; dry, moist 2-4 ft bgs, loose.	ML		1185.9	0 0 0 0	1	SS	7-8-6-7	14	1.0 2.0	
						0 0 0 0	2	SS	7-7-9-9	16	1.0 2.0	
5	1185	4.0 - 6.8 ML - CLAYEY SILT, brown, no odor; cohesive, moist, firm (4.5 ft bgs: coarse gravel with iron cementation on outside).	ML		4.0 1183.1	0 0 0 0	3	SS	4-4-6-7	10	1.1 2.0	
		6.8 - 6.8 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, loose.	SM CL		6.8 1181.9	0.4 0 0 0	4	SS	6-6-6-6	12	1.4 2.0	
		6.8 - 8.0 CL - SILTY CLAY; trace fine subangular gravel; brown, no odor; moist, firm.	CL CL		1181.0 6.8 1179.9	1.5 0.1 0 0	5	SS	7-7-13-12	20	1.3 2.0	
10	1180	8.0 - 8.8 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.	CL ML CL ML		10.8 1177.9	0.1 0.3 0.1 0.1	6	SS	3-5-6-6	11	1.3 2.0	
		8.8 - 10.0 CL - SILTY CLAY, some fine subangular gravel, brown, no odor; slighly moist, stiff.	SM CH		12.0 1176.5 1175.9	0 0 0	7	SS	6-7-9-9	16	2.0 2.0	
15	1175	10.0 - 10.2 CL - SILTY CLAY, brown, no odor; very moist, firm.	SM-CH		14.0 1173.9	0.1 N/A	8	SH	N/A	N/A	1.3 2.0	
		10.2 - 10.8 ML - SILT, brown, no odor; very moist, loose.										
		10.8 - 10.8 CL - SILTY CLAY, medium plasticity, brown, no odor; moist, firm.	CH		16.0 1171.2	0 0.1 0 0	9	SS	4-5-10-8	15	1.5 2.0	
		10.8 - 12.0 ML - SILT, grey, no odor; very moist, loose.	CL		18.7 1169.9	0 0 0 0	10	SS	11-10-10-10	20	1.5 2.0	
20	1170	12.0 - 13.3 SM - SILTY SAND, fine to coarse sand; trace subrounded gravel; brown, no odor; wet, loose to compact.	CL		20.0 1165.9	0 0 0 0	11	SS	2-3-5-5	8	1.2 2.0	
		13.3 - 14.0 CH - CLAY, high plasticity, grey, no odor; moist, firm (13.3-13.8 ft bgs: 0.1-inch silt laminations).				0 0 0 0	12	SS	6-8-9-8	17	1.1 2.0	
		14.0 - 16.0 Shelby Tube pushed 14-16 ft bgs (SILTY SAND and CLAY)			24.0 1163.9	N/A	13	SS	2-4-3-4	7	0.0 2.0	
25	1165	16.0 - 18.7 CH - CLAY, high plasticity, grey, no odor; moist, firm.	CL		26.0 1161.9	N/A	14	SS	2-3-3-2	6	0.7 2.0	
		18.7 - 20.0 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; moist, stiff.	CL		26.0 1159.9	N/A	15	SS	2-3-4-8	7	0.9 2.0	
		20.0 - 24.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft to firm.	CL CH CL		30.7 1157.9	N/A	16	SS	2-2-4-6	6	1.0 2.0	
30	1160	24.0 - 26.0 No Recovery	CL		32.0 1155.9	N/A	17	SS	7-8-8-11	16	1.0 2.0	
		26.0 - 26.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft (17 inches of very loose sandy SILT, fine to coarse sand, grey, no odor; wet. Possible Fall In from above).										
		26.0 - 30.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft to firm (17 inches of very loose sandy SILT, fine to coarse sand, grey, no odor; wet. Possible Fall In from above).	CL		34.0 1155.9	N/A	18	SS	1-4-6-7	7	1.3 2.0	
35	1155	30.0 - 30.3 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft.				N/A	19	SS	7-3-5-10	8	0.4 2.0	
		30.3 - 30.7 CH - CLAY, high plasticity, grey with red streaking, no odor; moist, soft.				N/A	20	SS	4-4-5-9	9	0.8 2.0	
40	1150	30.7 - 32.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft.			1149.2 40.7 1148.0	N/A	21	SS	4-5-42-50/2	47	1.5 2.0	
		32.0 - 34.0 CL - SILTY CLAY; fine to coarse subrounded to subangular gravel; grey, no odor; moist, firm to stiff										
45	1145	34.0 - 40.7 CL - SILTY CLAY; some subangular gravel;										

Log continued on next page

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE SB12-G62

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 41.9 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/19/12
DATE COMPLETED: 7/19/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,379.6 E: 244,686.4
GS ELEVATION: 1189.9 ft
TOC ELEVATION:
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
		grey, no odor; moist, soft to firm.										
		40.7 - 41.9 SILTSTONE - crushed siltstone GRAVEL, light grey; no odor; moist (Refusal at 41.9 ft bgs)										
		Boring completed at 41.9 ft										
50	1140											
55	1135											
60	1130											
65	1125											
70	1120											
75	1115											
80	1110											
85	1105											
90	1100											

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE SB12-G63

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 39.9 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/24/12
DATE COMPLETED: 7/24/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,563.1 E: 2,444,921.4
GS ELEVATION: 1195.9 ft
TOC ELEVATION:
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
0	1195	0.0 - 0.5 OL -Organic SILT, organics, dark brown, no odor; dry, compact.	OL		1195.4	0						
		0.5 - 3.0 ML - SILT; some fine subrounded gravel; brown, no odor; dry, compact.	ML		0.5 1192.9	0	1	SS	6-8-11-11	19	1.5/2.0	
		3.0 - 6.0 ML - CLAYEY SILT; some fine subangular gravel; brown-dark brown mottling, no odor; non-cohesive, moist, compact (4-6 ft bgs: coarse rounded to subrounded gravel).	ML		3.0 1189.9	0	2	SS	11-15-14-14	29	2.0/2.0	
5	1190					0	3	SS	7-7-10-9	17	0.4/2.0	
		6.0 - 6.7 CL - SILTY CLAY; some fine subrounded gravel, brown, no odor; moist, firm to stiff.	CL		1189.2	0						
		6.7 - 7.0 SM - SILTY SAND, fine sand; some fine subangular gravel; brown, no odor; moist, loose.	SM			0	4	SS	10-8-9-7	17	2.0/2.0	
		7.0 - 8.0 CL - SILTY CLAY; some fine subrounded gravel, brown, no odor; moist, firm.	CL		7.0 1187.9	0						
		8.0 - 10.0 CH - CLAY, medium plasticity; some fine subangular gravel; brown, no odor; moist, firm to stiff.	CH		8.0 1185.9	0	5	SS	10-7-10-7	17	1.5/2.0	
10	1185	10.0 - 10.4 CH - sandy CLAY, fine sand, brown, no odor; wet, soft.	CH		10.4	0	6	SS	2-4-6-7	10	1.4/2.0	
		10.4 - 12.0 CL - SILTY CLAY; some fine subangular gravel; brown, no odor; moist, firm (11.5 ft bgs: fine silty sand seam, brown; wet, loose).	CL		1183.9	0						
		12.0 - 12.5 ML - sandy SILT, fine sand, brown, no odor; wet, loose.	ML		1183.4	0	7	SS	5-5-7-8	12	2.0/2.0	
		12.5 - 13.5 CL - SILTY CLAY, some fine subangular gravel, grey, no odor; moist, firm.	CL		12.5 1182.4	0						
		13.5 - 13.7 SM - SILTY SAND, fine to coarse sand, grey, no odor; moist, loose.	SM			0						
		13.7 - 14.0 CL - SILTY CLAY, some fine subangular gravel, grey, no odor; moist, firm.	CL			0	8	SS	3-2-4-3	6	1.3/2.0	
		14.0 - 14.7 CL - SILTY CLAY, grey, no odor; moist, soft.	CL		1181.2	0						
15	1180	14.7 - 16.0 ML - SILT, grey-brown, no odor; wet, loose (0.25-inch CLAY laminations at 14.75, 14.8, 15.1, and 15.2 ft bgs; sand seam at 14.85 ft bgs; grey).	ML		14.7 1179.9	0						
		16.0 - 17.0 SM - SILTY SAND, fine sand, grey, no odor; wet, loose.	SM		16.0 1178.9	0	9	SS	6-5-6-4	11	1.5/2.0	
		17.0 - 20.8 SM - SILTY SAND, fine to coarse sand; some fine rounded to subrounded gravel; grey, no odor; wet, loose (18.75 ft bgs: 0.25-inch SILTY CLAY seam).	SM		17.0 1175.0	0	10	SS	8-5-5-5	10	1.3/2.0	
20	1175	20.8 - 22.9 CL - SILTY CLAY, grey, no odor; moist to very moist, soft (0.5-inch silt seams at 21.3 and 21.5 ft bgs, wet; 21.8 ft bgs: sandy SILT seam, wet, loose).	CL		20.8 1172.9	0	11	SS	3-2-4-4	6	1.8/2.0	
		22.9 - 26.0 ML - SILT, grey-brown, no odor; wet, soft to firm.	ML		22.9 1169.9	0	12	SS	3-4-4-7	8	1.4/2.0	
		26.0 - 26.3 CL - SILTY CLAY, grey, no odor; wet, soft.	CL		26.0 1167.6	0	13	SS	2-3-7-10	10	0.5/2.0	
		26.3 - 28.3 ML - sandy SILT, fine sand, grey-brown, no odor; wet, loose.	ML		1167.0	0	14	SS	7-9-8-7	17	0.5/2.0	
25	1170	28.3 - 28.8 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; moist, soft.	CL		28.8 1165.9	0						
		28.8 - 30.0 ML - SILT grey-brown, no odor; wet, loose.	CH			0	15	SS	2-2-3-5	5	1.0/2.0	
		30.0 - 30.1 CH - CLAY, high plasticity, grey, no odor; moist, soft.	ML			0						
		30.1 - 30.5 ML - SILT, grey-brown, no odor; wet, loose.	CL		30.6	0	16	SS	2-4-6-4	10	1.3/2.0	
			ML		1163.9	0						
30	1165		CL		32.0	0	17	SS	3-4-6-10	10	1.3/2.0	
					1161.9							
			CL		34.0	N/A	18	SH	N/A	N/A	1.5/2.0	
					1159.9							
			ML		1159.4	0						
			ML		36.5	0	19	SS	10-10-15-19	25	2.0/2.0	
					1157.9	0						
35	1160		GP		38.0	N/A	20	SS	27-29-30-50/5	59	1.3/1.9	
					1156.0							
40	1155											

Log continued on next page

LOG SCALE: 1 in = 5.5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE SB12-G63

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 39.9 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/24/12
DATE COMPLETED: 7/24/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,563.1 E: 2,444,921.4
GS ELEVATION: 1195.9 ft
TOC ELEVATION:
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	Sample Notes
45	1150	30.5 - 30.6 CL - SILTY CLAY, grey, no odor; wet, soft.										
		30.6 - 32.0 ML - SILT, grey-brown, no odor; wet, loose.										
		32.0 - 34.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft to firm (32.1 ft bgs: 0.5-inch silt seam).										
		34.0 - 36.0 Shelby Tube pushed 34-36 ft bgs (SILTY CLAY)										
50	1145	36.0 - 36.5 ML - SILT; some angular gravel; dark grey, no odor; moist, stiff.										
		36.5 - 38.0 ML - fractured siltstone gravel in dark grey SILT matrix, no odor; moist.										
		38.0 - 39.9 GP - weathered siltstone GRAVEL; dark grey, no odor, moist (Refusal at 39.9 ft bgs).										
55	1140	Boring completed at 39.9 ft										
60	1135											
65	1130											
70	1125											
75	1120											
80	1115											
85	1110											

LOG SCALE: 1 in = 5.5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD NO WELL SALEM OH ROC BORING LOGS.GPJ GOLDER.NJ.PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-52

SHEET 1 of 1

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 21.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

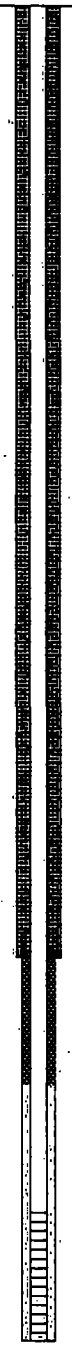
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/23/12
DATE COMPLETED: 7/24/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,400.5 E: 2,444,655.7
GS ELEVATION: 1191.1 ft
TOC ELEVATION: 1193.0 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0	1191	0.0 - 0.6 OL - Organic SILT, some organics, dark brown, no odor; dry, loose to compact.	OL		1190.5	0					
		0.6 - 2.0 ML- SILT, 0.6-0.75: light brown, 0.75-1.25: light grey with iron staining, 1.25-2.0: light brown-grey mottling, no odor; dry, loose to compact.	ML		0.6 1189.1	0 0 0	1	SS	7-8-11-10	19	2.0 2.0
	1190	2.0 - 4.0 ML- SILT; some subrounded to subangular gravel; brown, no odor; dry, compact.	ML		2.0 1187.1	0 0 0 0	2	SS	17-18-21-18	39	1.8 2.0
5		4.0 - 6.0 ML - SILT; some subangular gravel; brown, no odor; moist, loose.	ML		4.0 1185.1	0 0 0 0	3	SS	4-6-10-7	16	2.0 2.0
	1185	6.0 - 8.0 ML - SILT; trace coarse subrounded sandstone gravel; brown, no odor; moist, loose to compact (iron staining 6.25-6.33 ft bgs).	ML		6.0 1183.1	0 0 0 0	4	SS	8-10-12-9	22	0.7 2.0
		8.0 - 9.2 CL - SILTY CLAY; some fine subangular gravel; brown, no odor; moist, firm.	CL		8.0 1182.0	0.2 0.2 0.4	5	SS	9-6-8-6	14	2.0 2.0
		9.2 - 9.3 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, loose.	SM CL		9.3 1181.1	0.4					
10	1180	9.3 - 10.0 CL - SILTY CLAY; some fine subangular gravel; brown, no odor; moist, firm.	ML		10.0	0.3 2.0 1.6	6	SS	2-3-3-3	6	0.7 2.0
		10.0 - 12.0 ML - CLAYEY SILT; some fine subrounded to subangular gravel; brown, no odor; moist, soft.			1179.1	0.2					
		12.0 - 12.8 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel; brown, no odor; wet, loose.	SM ML CL		12.0 1178.5 1178.3 12.8 1177.6	1.6 3.2 1.7 0.4	7	SS	3-3-2-3	5	1.6 2.0
		12.8 - 12.8 ML - sandy SILT, fine sand; brown, no odor; moist, loose.	SM		13.5 1177.1						
		12.8 - 13.5 SM - SILTY CLAY; some fine subrounded gravel; brown, no odor; moist, soft.	SM		14.0 1176.1	0 0.1	8	SS	2-1	NA	1.0 1.0
15	1175	13.5 - 14.0 SM - SILTY SAND, fine sand; trace fine subangular gravel; brown, no odor; moist, loose.	SM ML		1175.7 1175.3	2.4 0.3					
		14.0 - 15.0 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, very loose (gradual increase in grain size with depth). Outer casing set at 15 ft bgs.	CL		15.8 1174.1	0.9 0.1	9	SS	1-1-2-4	3	1.1 2.0
		15.0 - 15.4 SM- SILTY SAND, fine to coarse sand, brown, no odor; wet, loose.	CH		17.0	0 0 0 0	10	SS	3-3-8-7	11	1.2 2.0
		15.4 - 15.8 ML - CLAYEY SILT, brown, no odor, slightly cohesive; wet, loose.									
		15.8 - 17.0 CL - SILTY CLAY, grey, no odor; wet, soft.				0 0					
20	1170	17.0 - 21.0 CH - CLAY, high plasticity, grey, no odor, moist, soft to firm (0.5-inch SILT seams at 17.4 and 17.75 ft bgs - compact, moist, grey, no odor).			1170.1	0 0	11	SS	3-4-5-5	9	0.6 2.0
		Boring completed at 21.0 ft									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW12-52
Borehole Diameter: 8-Inch
WELL CASING
Interval: 0-19 ft bgs
Material: PVC
Diameter: 2-inch
Joint Type: Threaded
WELL SCREEN
Interval: 19-21 ft bgs
Material: PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: Threaded
FILTER PACK
Interval: 17-21 ft bgs
Type: #2 Sand
Quantity: 4 ft
FILTER PACK SEAL
Interval: 15-17 ft bgs
Type: Bentonite
Quantity: 2 ft
ANNULUS SEAL
Interval: 0-15 ft bgs
Type: Bentonite/Cement Grout
Quantity: 15 ft

LOG SCALE: 1 in = 3 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ.PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-53

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 30.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/23/12
DATE COMPLETED: 7/24/12
WEATHER: Cloudy

DATUM: Local
COORDS: N: 458,389.4 E: 2,444,670.6
GS ELEVATION: 1190.8 ft
TOC ELEVATION: 1192.5 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES MW12-53	WELL CONSTRUCTION DETAILS
0	1190	0.0 - 2.0 ML - SILT; trace organics; brown, no odor, moist, loose to compact	ML		1188.8	0 0 0 0	1	SS	5-7-9-11	16	1.3 2.0		MW12-53 Borehole Diameter: 8-inch WELL CASING Interval: 0-27.5 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded WELL SCREEN Interval: 27.5-29.5 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded FILTER PACK Interval: 25.5-29.5 ft bgs Type: #2 Sand Quantity: 2-feet FILTER PACK SEAL Interval: 23.5-25.5 ft bgs Type: Bentonite Quantity: 2-feet ANNULUS SEAL Interval: 0-23.5 ft bgs Type: Bentonite/Cement Grout Quantity: 23.5-feet
		2.0 - 4.4 ML - SILT; some fine subrounded-subangular gravel; brown, no odor, moist, compact (2.83-3.25: iron staining, 4.17-4.33: SILTY SAND seam in SILT matrix - brown, no odor; moist, loose).	ML		2.0 1186.3	0 0 0 0	2	SS	9-12-14-10	26	1.3 2.0		
5	1185	4.4 - 10.1 ML - CLAYEY SILT; some fine subrounded-subangular gravel; brown, no odor; non-cohesive, moist, loose to compact, (4.83-5.0: iron staining, 7.25: iron encrusted SILT nodule).	ML		4.4 1180.7	0 0.2 0 0.5	3	SS	6-4-5-6	9	1.3 2.0		
						0.6 0.9 2.5 1.6	4	SS	10-8-10-9	18	1.5 2.0		
						1.8 1.7 0.8 0.7	5	SS	12-8-8-10	16	1.0 2.0		
10	1180	10.1 - 12.7 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel; brown, no odor, wet, loose .	SM		10.1 1178.1	0.1 0.2 0.2 0.3	6	SS	3-4-6-6	10	0.4 2.0	Bentonite/Cement Grout 0-24 ft bgs	
		12.7 - 12.9 CL - SILTY CLAY; trace fine subangular gravel; brown, no odor, moist, firm.	CL		12.9 1178.8	1.8 1.9 0.1 0.2	7	SS	4-4-4-7	8	1.8 2.0		
		12.9 - 14.0 CL - SILTY CLAY; little fine subangular gravel; brown, no odor; moist, firm.	SM ML		1176.2	0.8 0.6							
15	1175	14.0 - 14.8 SM - SILTY SAND, fine to coarse sand; little fine subangular gravel; brown, no odor; wet, very loose.	CH		14.8 1174.8 16.0 1174.0	0.1 0.6 0.2 8.6	8	SS	4-4-4-6	8	1.5 2.0		
		14.6 - 14.8 ML - SILT, brown, no odor; moist, loose.	CH		16.8 1172.8	0.2 0.1	9	SS	5-5-3-6	8	2.0 2.0		
		14.8 - 16.0 CH - CLAY, high plasticity, grey, no odor; moist, soft to firm.	SM		18.0 1171.8	10.2 3.7							
20	1170	16.0 - 16.8 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel; brown, no odor; wet, loose (gradual increase in grain size with depth).	CH		18.9	0.1 0.2 0.5 0.3	10	SS	4-3-2-5	5	2.0 2.0		
		16.8 - 18.0 CH - CLAY, high plasticity, grey, no odor; moist, firm.			1168.7	0.1 0.1	11	SS	2-2-3-3	5	1.0 2.0		
		18.0 - 18.9 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel; brown, no odor; wet, loose (gradual increase in grain size with depth, possible slough).	CL CH		1168.3 22.5 1166.8	0 0 0 0	12	SS	4-7-8-10	13	1.7 2.0	Outer casing set at 24 ft bgs	
25	1165	18.9 - 22.1 CH - CLAY, high plasticity, grey, no odor; moist, soft to firm (20.0-20.7: soft, 20.7-20.8: wet, very soft, 20.8-22.1: soft).	ML CH ML CH ML CH		25.2 1164.8	0 0.1 0 0.1	13	SS	3-4-6-5	10	1.3 2.0	Filter Pack Seal 23.5-25.5 ft bgs	
		22.1 - 22.5 CL - SILTY CLAY; some fine subangular gravel; brown-grey, no odor; wet, soft.	ML SM CH ML		26.4	0.5 0.5 0.5 0.5	14	SS	7-5-3-2	8	1.2 2.0	Filter Pack 25.5-29.5 ft bgs 0.010-inch Slot Screen	
		22.5 - 24.0 CH - CLAY; little fine to coarse subrounded to subangular gravel; high plasticity, grey, no odor; moist, firm (Set outer casing at 24 ft bgs).	SM CH ML SM SM		1161.8 28.9 1160.8	0.7 0.7 0.7 0.7	15	SS	5-4-5-8	9	1.7 2.0	Bentonite Fill 29.5-30 ft bgs	
30	1160	24.0 - 24.1 ML - SILT; trace fine sand; grey, no odor; wet, loose.	ML CH SM CL										
		24.1 - 24.3 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
		24.3 - 24.3 ML - SILT; trace fine sand; grey, no											

Log continued on next page

LOG SCALE: 1 in = 4 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-53

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 30.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/23/12
DATE COMPLETED: 7/24/12
WEATHER: Cloudy

DATUM: Local
COORDS: N: 458,389.4 E: 2,444,670.6
GS ELEVATION: 1190.8 ft
TOC ELEVATION: 1192.5 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
		odor; wet, loose.										MW12-53	
		24.3 - 24.4 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
35	1155	24.4 - 24.5 ML - SILT; trace fine sand; grey, no odor; wet, loose.											
		24.5 - 24.6 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
		24.6 - 24.7 ML - SILT; trace fine sand; grey, no odor; wet, loose.											
		24.7 - 24.8 SM - SILTY SAND, fine sand, brown-grey, no odor; wet, loose											
40	1150	24.8 - 24.8 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
		24.8 - 24.9 ML - SILT; trace fine sand; grey, no odor; wet, loose.											
		24.9 - 25.0 SM - SILTY SAND, fine sand, brown-grey, no odor; wet, loose.											
		25.0 - 25.1 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
45	1145	25.1 - 25.2 ML - SILT; trace fine sand; grey, no odor; wet, loose.											
		25.2 - 26.0 SM - SILTY SAND, fine sand, brown-grey, no odor; wet, loose.											
		26.0 - 26.3 SM - SILTY SAND, fine sand, brown-grey, no odor; wet, loose.											
		26.3 - 26.3 ML - SILT, brown-grey, no odor; wet, loose.											
50	1140	26.3 - 26.4 CH - CLAY, high plasticity, grey, no odor; moist, firm.											
		26.4 - 28.9 SM - SILTY SAND, fine to coarse sand; trace fine subangular gravel; brown-grey, no odor; wet, loose.											
		28.9 - 30.0 CL - SILTY CLAY; little fine subangular gravel; grey, no odor; moist, firm.											
		Boring completed at 30.0 ft											
55	1135												
60	1130												
65	1125												

MW12-53
Borehole Diameter: 8-inch
WELL CASING
Interval: 0-27.5 ft bgs
Material: PVC
Diameter: 2-inch
Joint Type: Threaded
WELL SCREEN
Interval: 27.5-29.5 ft bgs
Material: PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: Threaded
FILTER PACK
Interval: 25.5-29.5 ft bgs
Type: #2 Sand
Quantity: 2-feet
FILTER PACK SEAL
Interval: 23.5-25.5 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-23.5 ft bgs
Type: Bentonite/Cement Grout
Quantity: 23.5-feet

LOG SCALE: 1 in = 4 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA:\BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-54

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 44.3 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/18/12
DATE COMPLETED: 7/19/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,409.3 E: 2,444,661.6
GS ELEVATION: 1191.3 ft
TOC ELEVATION: 1192.9 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	1190	0.0 - 0.2 OL - Organic SILT, organics, dark brown, no odor; dry, compact.	OL		0.2	0						MW12-54	MW12-54 Borehole Diameter: 8-inch WELL CASING Interval: 0-36 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded WELL SCREEN Interval: 36-41 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded FILTER PACK Interval: 35-41 ft bgs Type: #2 Sand Quantity: 6-feet FILTER PACK SEAL Interval: 34-35 ft bgs Type: Bentonite Quantity: 2-feet ANNULUS SEAL Interval: 0-34 ft bgs Type: Bentonite/Cement Grout Quantity: 34-feet
		0.2 - 2.0 ML - SILT; some fine subrounded gravel; brown-grey mottling, no odor; dry, compact.	ML		2.0 1189.3	0	1	SS	11-13-14-12	27	1.4/2.0		
5	1185	2.0 - 4.0 ML - CLAYEY SILT, brown-grey mottling, no odor; moist, compact, non-cohesive.	ML		4.0 1187.3	0	2	SS	13-12-12-14	24	1.5/2.0		
		4.0 - 6.0 ML - SILT; some fine subrounded gravel; brown-grey mottling, no odor; moist, compact, non-cohesive.	CL		6.0 1185.3	0	3	SS	4-7-7-8	14	2.0/2.0		
10	1180	6.0 - 8.0 CL - SILTY CLAY; fine subrounded gravel; brown-grey mottling, no odor; moist to moist, firm to stiff (7.0-7.1 ft bgs: iron stained fine angular gravel seam).	CL		8.0 1183.3	NA	4	SS	10-8-10-8	18	1.4/2.0		
		8.0 - 10.0 CL - SILTY CLAY; some fine subangular gravel; brown, no odor; moist, firm to stiff.	CL		8.0 1181.3	NA	5	SS	10-9-7-10	16	1.0/2.0		
			CL		10.0 1179.3	0	6	SS	2-4-4-4	8	1.3/2.0		
15	1175	10.0 - 12.0 CL - SILTY CLAY; some fine subangular gravel; brown-grey mottling, no odor; moist, soft (10.1 ft bgs: 0.25-inch fine sand seam).	GM CL CL CH SM CH		10.0 1178.5 12.8 1176.8 14.9 1175.1 16.8 1174.5	0 0 0 1.5 2.9 6.1 3.1	7 8	SS SS	4-4-2-3 9-3-3-3	6 6	1.0/2.0 1.3/2.0	Bentonite/Cement Grout 0-34 ft bgs	
		12.0 - 12.8 GM - SILTY GRAVEL, fine to coarse subangular gravel, brown, no odor; wet, very loose.	CH		16.8 1171.3	0 0 0 0 0	9	SS	3-3-5-8	8	1.8/2.0		
20	1170	12.8 - 14.5 CL-SILTY CLAY; some fine subangular gravel; brown, no odor; moist, soft.	SM-CL		20.0 1169.3	0.1 0.3 0.5 0.2 NA	10 11	SS SH	5-5-7-9 N/A	12	1.5/2.0 1.8/2.0		
		14.5 - 14.5 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.	SM		22.0 1167.3	0 0 0 0 0	12	SS	2-3-5-7	8	1.3/2.0		
		14.5 - 14.9 CH - CLAY, high plasticity, brown, no odor; moist, firm to stiff.	CH		24.0 1166.0	0 0 0 0 0	13	SS	2-5-8-8	13	1.5/2.0		
25	1165	14.9 - 16.3 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, very loose.	ML CL		1165.3 26.0 1163.3	0 0 0 0 0	14	SS	8-7-9-9	16	1.2/2.0		
		16.3 - 16.8 CH - CLAY, high plasticity, brown, no odor; moist, firm.	ML SM ML		1162.6 28.9 1160.9	0 0 0 0 0	15	SS	7-9-9-25	18	1.3/2.0		
30	1160	16.8 - 20.0 CH - CLAY, high plasticity, grey, no odor; moist, firm.	CL		30.4 1158.3	0 0 0 0 0	16	SS	4-3-4-7	7	0.8/2.0		
		20.0 - 22.0 Shelby Tube pushed 20-22 ft bgs (SILTY SAND and CLAY)	ML		32.2	0 0 0 0 0	17	SS	5-7-8-9	15	1.3/2.0	Outer casing set at 34 ft bgs	
35	1155	22.0 - 24.0 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, very loose (gradual increase in grain size with depth; 1-inch CLAY seam at 22.67 ft bgs).	CL		1154.7	0.9 0.9 0.9 0.9	18	SS	5-5-8-10	13	1.0/2.0	Filter Pack / Seal 34-35 ft bgs	
		24.0 - 25.3 CH - CLAY, high plasticity, grey, no odor; moist, soft to firm (24.6-24.9 ft bgs: 0.1-0.2-inch silt laminations).	SM		36.6 1153.3	1.4 1.4 1.4 1.4	19	SS	11-13-16-12	29	0.9/2.0		
40	1150	25.3 - 28.0 ML - SILT, grey-brown, no odor; moist, loose (25.3 ft bgs: fine sand seam in silt matrix).	CL SP GP		38.5 1151.3	1.6 1.6 1.6 1.6	20	SS	7-10-10-11	20	1.1/2.0	Filter Pack 35-41 ft bgs 0.010-Inch Slot Screen 36-41 ft bgs	
		28.0 - 28.0 CL - sandy SILTY CLAY; fine sand; grey-brown, no odor; moist, firm (0.1-inch sand laminations at 26.75 and 27.0 ft bgs).	CL		40.0 1150.3	1.6 1.6 1.6 1.6	21	SS	2-2-6-32	8	1.5/2.0	Bentonite Fill 41-41.3 ft bgs	
45	1145	28.0 - 28.8 ML - SILT; trace fine sand; trace fine subangular gravel; grey-brown, no odor; moist, firm.	ML		41.0 1148.2	1.6 1.6 1.6 1.6 1.6	22	SS	14-40-50/3	>90	1.3/1.3		
		28.8 - 28.9 SM - SILTY SAND, fine sand, grey-brown, no odor; moist, loose.			43.3	1.6 1.6 1.6 1.6 1.6							
		28.9 - 30.4 ML - SILT; trace fine sand; trace fine											

Log continued on next page

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-54

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 44.3 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/18/12
DATE COMPLETED: 7/19/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,409.3 E: 2,444,661.6
GS ELEVATION: 1191.3 ft
TOC ELEVATION: 1192.9 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES MW12-54	WELL CONSTRUCTION DETAILS
50	1140	subangular gravel; grey-brown, no odor; moist, firm to stiff.											**MW12-54** Borehole Diameter: 8-inch **WELL CASING** Interval: 0-36 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded **WELL SCREEN** Interval: 36-41 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded **FILTER PACK** Interval: 35-41 ft bgs Type: #2 Sand Quantity: 6-feet **FILTER PACK SEAL** Interval: 34-35 ft bgs Type: Bentonite Quantity: 2-feet **ANNULUS SEAL** Interval: 0-34 ft bgs Type: Bentonite/Cement Grout Quantity: 34-feet
		30.4 - 32.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.											
55	1135	32.0 - 32.2 ML - SILT; trace fine sand; grey-brown, no odor; moist, firm.											
		32.2 - 36.6 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm (outer casing set at 34 ft bgs).											
		36.6 - 38.0 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel; grey, no odor; moist, compact.											
60	1130	38.0 - 38.4 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.											
		38.4 - 38.5 SP - fine sand, tan, no odor; wet, loose.											
		38.5 - 40.0 GP - crushed SANDSTONE gravel, brown to white, no odor; wet.											
65	1125	40.0 - 41.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, soft.											
		41.0 - 43.1 ML - weathered siltstone, light grey, moist.											
		43.1 - 43.3 SILTSTONE - crushed siltstone gravel, light grey (Refusal at 43.3 ft bgs).											
70	1120	Boring completed at 44.3 ft											
75	1115												
80	1110												
85	1105												
90	1100												
95	1095												

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA\BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-55

SHEET 1 of 1

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 31.5 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd. Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/9/12
DATE COMPLETED: 7/16/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,650.3 E: 2,445,000.0
GS ELEVATION: 1196.1 ft
TOC ELEVATION: 1197.7 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 0.5 OL - Organic SILT, some organics; fine to coarse angular gravel; dark brown; moist.	OL		1195.6 / 0.5	0 0 0 0	1	SS	8-8-6-8	12	1.0 / 2.0
	1195	0.5 - 2.0 ML - SILT; some fine sand; some fine subangular gravel; tan, no odor; non-cohesive, moist.	ML		1194.1 / 2.0	0 0 0 0	2	SS	6-8-9-10	17	1.5 / 2.0
		2.0 - 2.8 ML - sandy SILT, fine sand; some fine angular to subangular gravel; tan, no odor; non-cohesive, moist.	ML		1193.3 / 2.8	0 0 0 0	3	SS	3-4-5-5	9	1.5 / 2.0
5		2.8 - 4.0 ML - CLAYEY SILT; trace fine sand; tan-grey-dark brown mottled, no odor; moist, firm.	ML		1192.1 / 4.0	0 0 0 0	4	SS	4-6-6-7	12	2.0 / 2.0
	1190	4.0 - 6.0 ML - SILT; some fine subrounded to subangular gravel; tan, no odor; moist, loose.	CL		1190.1 / 6.0	0 0 0 0	5	SS	11-11-8-7	19	1.5 / 2.0
		6.0 - 7.7 CL - SILTY CLAY; some fine subrounded to subangular gravel; tan, no odor; moist, soft to firm.	CL		1188.5 / 8.0	0 0 0 0	6	SS	1-1-1-1	2	1.3 / 2.0
10		7.7 - 8.0 CL - sandy SILTY CLAY, fine to coarse sand; some fine subrounded to subangular gravel; tan, no odor; moist, soft to firm.	ML		1186.7 / 8.0	0 1.7 0 0	7	SS	4-4-5-3	9	2.0 / 2.0
	1185	8.0 - 9.4 ML - CLAYEY SILT; trace fine to coarse subrounded to subangular gravel; brown, no odor; moist, loose to compact.	SM		1186.1 / 10.0	7.6 1.6 0 0	8	SS	1-2-4-4	6	1.3 / 2.0
		9.4 - 10.0 SM - SILTY SAND, fine to coarse sand, brown, no odor; moist, loose.	CL		1185.0 / 11.2	0 0 0 0	9	SS	6-14-10-9	24	1.2 / 2.0
15		10.0 - 11.2 SM - SILTY SAND; fine to coarse sand; brown, no odor; wet, very loose.	SM		1184.1 / 12.5	0 0 0 0	10	SS	2-4-6-8	10	1.3 / 2.0
	1180	11.2 - 12.0 CL - SILTY CLAY, brown, no odor; wet, very soft.	CL		1180.1 / 16.0	0 0 0 0	11	SS	4-4-6-5	10	1.3 / 2.0
		12.0 - 12.5 SM - SILTY SAND, fine to coarse sand, brown, no odor; wet, loose.	CL		1179.3 / 16.8	0 0 0 0	12	SS	3-5-8-8	13	0.9 / 2.0
		12.5 - 16.0 CL - SILTY CLAY ; some fine subrounded gravel; brown-grey, no odor, moist, soft.	CL		1178.1 / 18.0	0 0 0 0	13	SS	2-3-3-5	6	1.3 / 2.0
20		16.0 - 16.8 CL - SILTY CLAY ; some fine subrounded gravel; grey, no odor; moist, firm to stiff.	CL		1176.1 / 20.0	0 0 0 0	14	SS	4-5-7-8	12	2.0 / 2.0
	1175	16.8 - 18.0 CL - sandy SILTY CLAY, fine sand, grey, no odor; non-cohesive, wet, loose.	CL		1174.1 / 22.0	0 0 0 0	15	SS	4-3-7-9	10	1.3 / 2.0
		18.0 - 24.0 CL - SILTY CLAY; some fine subrounded to subangular gravel; grey, no odor; moist, soft to firm (Set outer casing at 20 ft bgs).	CH		1172.1 / 24.0	0 0 0 0	16	SS	9-10-12	22	1.5 / 1.5
25		24.0 - 26.8 CH - CLAY; trace fine to coarse subrounded to subangular gravel; grey, no odor; moist, soft to firm (24.6-24.85; fine sand in CLAY matrix; moist, firm).	CH		1169.3 / 26.8						
	1170	26.8 - 27.3 gravelly CLAY, subangular gravel, grey-brown, no odor; wet, loose.	CH		1168.9 / 27.3						
		27.3 - 31.5 CH - CLAY; trace fine to coarse subrounded to subangular gravel; grey, no odor; moist, soft to firm.	CH		1164.6 / 31.5						
30	1165	Boring completed at 31.5 ft									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES — MW12-55

Bentonite/Cement Grout 0-20 ft bgs
Outer casing set at 20 ft bgs
Filter Pack Seal 20-22 ft bgs
Filter Pack 22-29 ft bgs 0.010-inch Slot Screen 24-29 ft bgs
Bentonite Fill 29-31.5 ft bgs

WELL CONSTRUCTION DETAILS

MW12-55
Borehole Diameter: 8-Inch
WELL CASING
Interval: 0-24 ft bgs
Material: PVC
Diameter: 2-Inch
Joint Type: Threaded
WELL SCREEN
Interval: 24-29 ft bgs
Material: PVC
Diameter: 2-Inch
Slot Size: 0.010-Inch
End Cap: Threaded
FILTER PACK
Interval: 22-29 ft bgs
Type: #2 Sand
Quantity: 7-feet
FILTER PACK SEAL
Interval: 20-22 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-20 ft bgs
Type: Bentonite/Cement Grout
Quantity: 20-feet

LOG SCALE: 1 in = 4.5 ft
DRILLING COMPANY: Frontx Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER.NJ.PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-56

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 44.5 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/10/12
DATE COMPLETED: 7/13/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,673.5 E: 2,445,015.1
GS ELEVATION: 1195.2 ft
TOC ELEVATION: 1197.1 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	PID (ppm)	SAMPLES NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	1195	0.0 - 0.3 OL- Organic SILT organics; some coarse subrounded gravel; dark brown; no odor; non-cohesive, dry, loose.	OL		0.3	0	1	SS	12-12-14-16	26	1.3 / 2.0	MW12-56	MW12-56 Borehole Diameter: 8-inch WELL CASING Interval: 0-39.5 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded WELL SCREEN Interval: 39.5-44.5 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded FILTER PACK Interval: 37.5-44.5 ft bgs Type: #2 Sand Quantity: 7-feet FILTER PACK SEAL Interval: 35.5-37.5 ft bgs Type: Bentonite Quantity: 2-feet ANNULUS SEAL Interval: 0-35.5 ft bgs Type: Bentonite/Cement Grout Quantity: 35.5-feet
		0.3 - 2.0 ML - SILT; some fine subangular gravel; tan, no odor; non-cohesive, dry, compact.	ML		1193.2 2.0	0	2	SS	17-20-21-21	41	1.3 / 2.0		
5	1190	2.0 - 5.1 ML - SILT; some fine subangular gravel; tan-grey-dark brown mottling, no odor; non-cohesive, dry, compact (4.2-5.1 ft bgs: loose).	ML		1190.1	0	3	SS	4-10-10-11	20	1.5 / 2.0		
		5.1 - 6.0 CL - SILTY CLAY, grey and brown, no odor; dry, stiff (0.1-inch silt laminations at 5.2 and 5.25 ft bgs).	CL		1189.2	0	4	SS	11-10-10-9	20	2.0 / 2.0		
10	1185	6.0 - 6.4 ML - SILT, dark brown, no odor; non-cohesive, dry, loose.	ML		1187.7	0	5	SS	7-7-6-5	13	1.8 / 2.0		
		6.4 - 6.6 SM - SILTY SAND, fine sand, brown, no odor; non-cohesive, moist, loose.	SM		1186.0	0	6	SS	2-3-3-4	6	0.9 / 2.0		
		6.6 - 6.8 SM - gravelly SILTY SAND, fine sand, fine to coarse angular gravel, brown, no odor; non-cohesive, moist, loose.	SM		1185.2	0	7	SS	4-3-3-2	6	1.3 / 2.0		
15	1180	6.8 - 7.5 CL - SILTY CLAY; some fine to coarse subangular gravel; brown, no odor; moist, stiff.	CL		1184.5 10.8	0	8	SS	2-2-3-2	5	1.3 / 2.0		
		7.5 - 7.8 CL - sandy SILTY CLAY, fine sand, brown, no odor; moist, firm (7.8-7.9 ft bgs: 0.5-inch coarse sand seams 1-inch apart).	CL		1183.2 12.3	0	9	SS	4-6-7-11	13	1.5 / 2.0	Bentonite/Cement Grout 0-35.5 ft bgs	
20	1175	7.8 - 8.3 ML - CLAYEY SILT; some subrounded to subangular gravel; brown, no odor; moist, firm.	ML		1181.2 14.0	0	10	SS	10-10-12-17	22	0.9 / 2.0		
		8.3 - 8.6 SM - SILTY SAND, fine sand; some fine subrounded gravel; dark brown; moist, loose.	SM		1175.2 20.0	0	11	SH	N/A		1.2 / 2.0		
		8.6 - 9.2 CL - SILTY CLAY, brown, no odor; cohesive, moist, firm.	CL		1173.2 22.0	N/A	12	SS	5-7-8-8	15	1.0 / 2.0		
25	1170	9.2 - 9.3 SM - SILTY SAND, fine to coarse sand, brown; moist.	CL		1171.2 1170.6	0	13	SS	2-1-2-1	3	1.0 / 2.0		
		9.3 - 10.0 CL - SILTY CLAY, brown, no odor; cohesive, moist, soft.	SC		24.9	0	14	SS	2-3-4-5	7	1.8 / 2.0		
		10.0 - 10.8 CL - SILTY CLAY, tan, no odor; cohesive, moist, soft (10.5-10.6 ft bgs: fine gravel seam).	CL		1168.8 26.7	0	15	SS	6-9-12-14	2	2.0 / 2.0		
		10.8 - 12.0 SM - SILTY SAND, fine to medium sand; some fine subangular gravel; dark brown; moist, loose (iron concretion at 10.75 ft bgs).	SC		1167.2 1166.4	0	16	SS	2-4-5-10	9	1.3 / 2.0		
30	1165	12.0 - 12.3 CL - SILTY CLAY, dark brown, no odor; cohesive, moist, soft.	CL		28.8	0	17	SS	11-12-16-20	28	1.8 / 2.0		
		12.3 - 14.0 SM - SILTY SAND, fine to coarse sand, grey to 12.2 ft bgs, brown 12.2-13.25 ft bgs; fine angular to subangular gravel 12.85-13.25 ft bgs; wet, loose.	CL		1160.2 1159.8	0	18	SS	14-16	N/A	1.0 / 1.0	Outer casing set at 35 ft bgs	
35	1160	14.0 - 20.0 CL - SILTY CLAY; some fine gravel; grey, no odor; cohesive, moist, soft to firm (18-20 ft bgs: SAA but firm; 19 ft bgs: Coarse gravel).	CH		35.6	0	19	SS	1-2-3-7	5	0.9 / 2.0	Filter Pack Seal / 35.5-37.5 ft bgs	
		20.0 - 22.0 Shelby Tube pushed 20-22 ft bgs. (CLAY)	SM		1157.4	0	20	SS	4-5-5-7	10	2.0 / 2.0		
40	1155	22.0 - 24.0 CL - SILTY CLAY; trace fine angular to subangular gravel; grey, no odor; cohesive, moist, firm.	CL		37.8	0	21	SS	2-3-6-6	9	1.2 / 2.0	Filter Pack 37.5 44.5 ft bgs 0.010-inch / Slot Screen	
		24.0 - 24.6 CL - SILTY CLAY, grey, no odor; moist,				0	22	SS	4-5-6-7	11	1.5 / 2.0		
45	1150	Log continued on next page.			1150.8	0	23	SS	3-5-50/5	>55	1.5 / 1.5		

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/16/12

RECORD OF BOREHOLE MW12-56

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 44.5 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/10/12
DATE COMPLETED: 7/13/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,673.5 E: 2,445,015.1
GS ELEVATION: 1195.2 ft
TOC ELEVATION: 1197.1 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES (MW12-56)	WELL CONSTRUCTION DETAILS
		soft.											
50	1145	24.6 - 24.9 SC - CLAYEY SAND, fine to coarse sand; some fine subrounded to subangular gravel; grey, no odor; wet, very loose.											
		24.9 - 26.4 CL - SILTY CLAY, grey, no odor, moist to wet, soft.											
55	1140	26.4 - 26.7 SC - CLAYEY SAND, fine to coarse sand; trace fine gravel.											
		26.7 - 28.0 CL - SILTY CLAY, some fine sand; some fine angular to subangular gravel; grey, no odor; moist, soft to firm.											
60	1135	28.0 - 28.8 CL - SILTY CLAY; trace coarse sand; trace fine angular gravel; grey, no odor; wet, firm.(1-inch coarse sand seams at 28.4, 28.6, and 28.75 ft bgs).											
		28.8 - 35.0 CL - SILTY CLAY; some angular to subangular gravel; grey, no odor; moist, firm to stiff with depth (set outer casing at 35 ft bgs).											
65	1130	35.0 - 35.6 CH - CLAY, high plasticity; some subangular gravel; grey, no odor; cohesive, wet, soft.											
		35.6 - 37.8 SM - SILTY SAND, fine sand, grey, no odor; non-cohesive, wet, loose to compact.											
70	1125	37.8 - 44.4 CL - SILTY CLAY; some subrounded to subangular gravel; grey, no odor; cohesive, wet, firm (38.4 ft bgs: 1-inch sand seam, grey, no odor; wet, loose: 39.1 ft bgs: 0.2-inch sand seam, fine sand, grey, no odor; wet, loose).											
		44.4 - 44.5 SILTSTONE - crushed siltstone gravel, grey (Refusal at 44.5 ft bgs).											
75	1120	Boring completed at 44.5 ft											
80	1115												
85	1110												
90	1105												
95	1100												

MW12-56
Borehole Diameter: 8-inch
WELL CASING
Interval: 0-39.5 ft bgs
Material: PVC
Diameter: 2-inch
Joint Type: Threaded
WELL SCREEN
Interval: 39.5-44.5 ft bgs
Material: PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: Threaded
FILTER PACK
Interval: 37.5-44.5 ft bgs
Type: #2 Sand
Quantity: 7-feet
FILTER PACK SEAL
Interval: 35.5-37.5 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-35.5 ft bgs
Type: Bentonite/Cement Grout
Quantity: 35.5-feet

LOG SCALE: 1 in = 6 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-57

SHEET 1 of 1

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 15.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd. Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/17/12
DATE COMPLETED: 7/17/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,372.3 E: 2,444,698.6
GS ELEVATION: 1189.6 ft
TOC ELEVATION: 1191.5 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES (MW12-57)	WELL CONSTRUCTION DETAILS
0		0.0 - 0.2 OL - Organic SILT, organics, dark brown, no odor; moist, loose.	OL		1189.5 0.2	0							MW12-57 Borehole Diameter: 8-inch WELL CASING Interval: 0-10 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded WELL SCREEN Interval: 10-15 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded FILTER PACK Interval: 8-15 ft bgs Type: #2 Sand Quantity: 7-feet FILTER PACK SEAL Interval: 6-8 ft bgs Type: Bentonite Quantity: 2-feet ANNULUS SEAL Interval: 0-6 ft bgs Type: Bentonite/Cement Grout Quantity: 6-feet
		0.2 - 2.0 ML - SILT; trace fine subangular gravel; light brown-grey mottling, no odor; moist, loose to compact.	ML		1187.8	0	1	SS	4-5-8-11	13	2.0/2.0		
		2.0 - 5.2 ML - CLAYEY SILT; some fine subrounded to subangular gravel; brown, no odor; moist, compact (0.2-inch silt seams at 2.2, 2.3, and 3.2 ft bgs; coarse sand seam in silt matrix at 2.7 ft bgs).	ML		2.0	0	2	SS	11-9-9-10	18	1.2/2.0	Bentonite/Cement Grout 0-6 ft – bgs	
5	1185				1184.5	0	3	SS	4-5-8-4	13	1.7/2.0		
		5.2 - 5.4 ML - gravelly SILT, fine subangular gravel, no odor; moist, loose (iron staining on silt matrix).	ML		1184.2 5.4	0							
		5.4 - 6.2 ML - SILT, brown, no odor; non-cohesive, wet, loose.	ML		1183.5 6.3	0							
		6.2 - 6.3 ML - gravelly SILT, fine subangular gravel, dark brown, no odor; moist, loose.	CL		1182.6	0	4	SS	8-8-8-5	14	1.7/2.0	Filter Pack Seal 6-8 ft – bgs	
		6.3 - 7.0 CL - SILTY CLAY, 6.25-6.7 ft bgs brown, 6.7-7 ft bgs grey, no odor; moist, firm.			7.0								
10	1180	7.0 - 10.8 CH - CLAY, high plasticity, grey (brown 10.6-10.75 ft bgs), no odor; moist, soft to stiff.	CH		1178.9	0	5	SS	2-2-6-11	8	2.0/2.0		
		10.8 - 12.0 SM - SILTY SAND, fine to coarse sand; some fine subrounded to subangular gravel; brown, no odor; dry, loose to compact.	SM		10.8 1177.6	0	6	SS	8-14-12-7	26	1.5/2.0	Filter Pack 8-15 ft bgs	
		12.0 - 13.0 CH - CLAY, high plasticity, grey, no odor; moist, firm.	CH		12.0 1176.6	0	7	SS	3-4-7-6	11	1.5/2.0	0.010-inch Slot Screen – 10-15 ft bgs	
		13.0 - 13.2 CL - SILTY CLAY, grey-brown, no odor; wet, firm.	CL		1176.5 13.2								
15	1175	13.2 - 15.0 CH - CLAY, high plasticity, grey, no odor; moist, firm.	CH		1174.6	0	8	SS	10-8	N/A	0.7/1.0		
		Boring completed at 15.0 ft											

LOG SCALE: 1 in = 2 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-58

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 41.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/17/12
DATE COMPLETED: 7/18/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,362.6 E: 2,444,712.8
GS ELEVATION: 1189.5 ft
TOC ELEVATION: 1191.2 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 0.3 OL - Organic SILT, organics, brown, no odor; dry, loose.	OL		0.3	0	1	SS	8-9-11-14	20	2.0/2.0
		0.3 - 2.0 ML - SILT; trace fine subangular to angular gravel; brown-grey mottling, no odor; dry, compact.	ML		1187.5 2.0	0	2	SS	12-11-14-14	25	1.5/2.0
	1185	2.0 - 3.3 ML - SILT; trace fine subrounded gravel; brown, no odor; moist, compact (0.1-inch fine sand seam at 3.2 ft bgs).	ML		1186.2 1185.5 1184.7 4.8	0	3	SS	4-14-18-18	32	0.8/2.0
5		3.3 - 4.0 ML - CLAYEY SILT; trace fine subrounded gravel; brown, no odor; moist, compact.	ML CL		1183.5 1182.6 6.9	0	4	SS	22-17-16-12	33	1.3/2.0
	1180	4.0 - 4.8 ML - SILT; trace fine sand; trace fine subangular gravel; brown, no odor; moist, compact.	CH			0	5	SS	14-12-15-10	27	0.2/2.0
10		4.8 - 6.0 ML - sandy SILT, fine sand; some fine subangular gravel; light brown, no odor; dry, loose.	SM		1178.7 10.8 1177.5	0	6	SS	3-12-15-10	27	1.5/2.0
		6.0 - 6.2 ML - CLAYEY SILT, brown, no odor; non-cohesive, moist, firm.	CH		12.0	0	7	SS	12-11-10-9	21	1.1/2.0
	1175	6.2 - 6.9 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; cohesive, moist, firm.				0	8	SS	4-4-4-8	8	1.1/2.0
15		6.9 - 10.8 CH - CLAY, medium to high plasticity, grey, no odor; moist, firm to stiff (10.3-10.8 ft bgs: brown).				0	9	SS	8-9-8-9	17	1.7/2.0
		10.8 - 12.0 SM - SILTY SAND, fine to coarse sand; some fine subangular gravel, brown, no odor; moist, loose.				0	10	SS	12-8	N/A	1.0/1.0
	1170	12.0 - 19.8 CH - CLAY, high plasticity, grey, no odor; moist, firm to stiff (12.0-12.1 ft bgs: brown; 18-19 ft bgs: soft; set outer casing at 19 ft bgs).	CH/ML CH CH ML SW CH		1169.7 1169.1 1168.5 1167.7 1167.0	0	11	SS	1-3-3-5	6	2.0/2.0
20		19.8 - 20.4 CH - CLAY, high plasticity, grey, no odor; moist to wet, soft to firm (0.1-0.2-inch silt laminations, brown).	ML CL GC		23.0 1165.5 24.2	0	12	SS	8-8-8-8	16	2.0/2.0
	1165	20.4 - 21.0 CH - CLAY, high plasticity, grey, no odor; moist to wet, soft to firm.	CL		1162.5	0	13	SS	1-7-7-7	14	1.8/2.0
25		21.0 - 21.8 CH - CLAY, medium plasticity, grey, no odor; wet, soft (0.1-0.2-inch silt laminations at 21.3, 21.5, and 21.75 ft bgs).	CL		27.0 1160.5	0	14	SS	3-4-7-7	11	0.7/2.0
	1160	21.8 - 21.9 ML - SILT, grey, no odor; wet, soft.	CL		29.0	0	15	SS	9-10-10-11	20	2.0/2.0
30		21.9 - 22.5 SW - SAND, fine to coarse sand; some fine subrounded to subangular gravel; trace silt, brown, no odor; wet loose.	CL		1157.2	0	16	SS	2-2-5-5	7	1.3/2.0
		22.5 - 22.8 CH - CLAY, medium plasticity, grey, no odor; wet, firm.	CL		32.4	0	17	SS	5-7-8-8	13	1.8/2.0
	1155	22.8 - 23.0 ML - SILT, grey, no odor; wet, soft.	CL			0	18	SS	3-3-5-8	8	1.1/2.0
35		23.0 - 24.0 CL - SILTY CLAY, some fine subangular gravel, grey, no odor, moist, firm.				0	19	SS	2-3-4-8	7	1.3/2.0
		24.0 - 24.2 GC - CLAYEY GRAVEL, fine subangular gravel; some coarse sand; grey, no odor; wet, loose.				0	20	SS	4-8-14-14	20	1.3/2.0
	1150	24.2 - 27.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.			1148.5	0	21	SS	2-4-7-10	11	1.0/2.0
40		27.0 - 29.0 CL - gravelly SILTY CLAY, fine subangular gravel; trace coarse sand; grey, no odor; wet, stiff.									
	1145	29.0 - 32.3 CL - SILTY CLAY; some fine Log continued on next page									
45											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

MW12-58

Bentonite/Cement Grout 0-31 ft bgs

Outer Casing Set 0-19 ft bgs

Filter Pack Seal 31-33 ft bgs

Filter Pack 33-40 ft bgs

0.010-inch Slot Screen 35-40 ft bgs

Bentonite Fill 40-41 ft bgs

WELL CONSTRUCTION DETAILS

MW12-58
Borehole Diameter: 8-inch
WELL CASING
Interval: 0-35 ft bgs
Material: PVC
Diameter: 2-inch
Joint Type: Threaded
WELL SCREEN
Interval: 35-40 ft bgs
Material: PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: Threaded
FILTER PACK
Interval: 33-40 ft bgs
Type: #2 Sand
Quantity: 7-feet
FILTER PACK SEAL
Interval: 31-33 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-31 ft bgs
Type: Bentonite/Cement Grout
Quantity: 31-feet

LOG SCALE: 1 in = 5.5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-58

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 41.0 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/17/12
DATE COMPLETED: 7/18/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,362.6 E: 2,444,712.8
GS ELEVATION: 1189.5 ft
TOC ELEVATION: 1191.2 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
		subangular to angular gravel; grey, no odor; moist, soft to firm.										MW12-58	MW12-58 Borehole Diameter: 8-inch WELL CASING Interval: 0-35 ft bgs Material: PVC Diameter: 2-inch Joint Type: Threaded WELL SCREEN Interval: 35-40 ft bgs Material: PVC Diameter: 2-inch Slot Size: 0.010-inch End Cap: Threaded FILTER PACK Interval: 33-40 ft bgs Type: #2 Sand Quantity: 7-feet FILTER PACK SEAL Interval: 31-33 ft bgs Type: Bentonite Quantity: 2-feet ANNULUS SEAL Interval: 0-31 ft bgs Type: Bentonite/Cement Grout Quantity: 31-feet
		32.3 - 32.4 CL - sandy SILTY CLAY, fine sand, grey; no odor; cohesive, wet, soft.											
		32.4 - 41.0 CL - SILTY CLAY; some fine subangular to angular gravel; grey, no odor; moist, soft to firm.											
50	1140	Boring completed at 41.0 ft											
55	1135												
60	1130												
65	1125												
70	1120												
75	1115												
80	1110												
85	1105												
90	1100												

LOG SCALE: 1 in = 5.5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-59

SHEET 1 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 37.6 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/16/12
DATE COMPLETED: 7/16/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,313.3 E: 2,444,780.8
GS ELEVATION: 1185.4 ft
TOC ELEVATION: 1187.3 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES
0	1185	0.0 - 0.8 OL - Organic SILT, organics, brown, no odor; moist, loose.	OL		1184.7	0.1						
		0.8 - 2.0 ML - SILT, brown, no odor; non-cohesive, dry, compact.	ML		0.8 1183.4	0.2 0.3 0.2	1	SS	3-6-9-11	15	1.5/2.0	
		2.0 - 4.0 ML - SILT; trace fine gravel; brown-grey mottling, no odor; non-cohesive, moist, compact to dense.	ML		2.0 1181.4	0.1 0.1 0.1 0.1	2	SS	16-28-32-38	60	2.0/2.0	
5	1180	4.0 - 4.1 SM - SILTY SAND, fine sand, brown, no odor; moist, loose.	SM ML ML SM		4.1 1180.3 1179.7 1179.0	0.1 0.1 0.1 0.1	3	SS	12-11-12-10	23	2.0/2.0	
		4.1 - 5.1 ML - SILT, brown-grey mottling, no odor; non-cohesive, moist, compact.	SM ML SM		6.8 1177.4	0.1 0.1 0.1	4	SS	6-8-10-9	18	1.5/2.0	
		5.1 - 5.7 ML - sandy SILT, fine sand, tan, no odor; moist, loose.	ML CL		8.0 1176.6	0 0	5	SS	2-3-3-5	6	1.3/2.0	
10	1175	5.7 - 5.8 ML - SILT, brown-grey mottling, no odor; non-cohesive, moist, compact.	SM		8.8 1175.4	0 0	6	SS	9-8-11-11	19	0.8/2.0	Bentonite/Cement Grout 0-22 ft bgs
		5.8 - 6.0 SM - SILTY SAND, fine to coarse sand, brown, no odor; moist, loose.	CL SW		10.5 1174.9 1173.4	0 0 0						
		6.0 - 6.4 SM - SILTY SAND, fine sand, brown, no odor; moist, loose.	CH		12.2 1171.4	0 0 0	7	SS	2-2-4-3	6	1.8/2.0	
15	1170	6.4 - 6.6 ML - sandy SILT, fine sand, brown-grey mottling, no odor; non-cohesive, moist, loose to compact.	CH		14.0 1168.4	N/A	8	SH	N/A	N/A	1.8/2.0	
		6.6 - 6.8 SM - SILTY SAND, fine sand, brown, no odor; moist, loose.	SW		16.0 1168.2	0 0 0	9	SS	6-4-9-5	13	2.0/2.0	
		6.8 - 8.0 ML - CLAYEY SILT; trace fine gravel; brown with grey laminations 7.2-7.6 ft bgs; no odor; moist, firm.	CH CH CH		17.2 1167.4 1166.7 18.9	0 0 0 0	10	SS	2-3-3-4	6	1.8/2.0	
20	1165	8.0 - 8.8 CL - SILTY CLAY; trace fine to coarse rounded to subrounded gravel; brown, no odor; cohesive, moist, soft to firm.	CH		1164.5	0 0 0 0	11	SS	4-5-6-8	11	1.3/2.0	
		8.8 - 10.0 SM - SILTY SAND, fine to medium sand, brown, no odor; wet, loose.	CH SW		21.0 1162.5	0 0 0 0	12	SS	3-2-2-2	4	1.7/2.0	Filter Pack Seal 22-24 ft bgs
		10.0 - 10.5 CL - SILTY CLAY, light brown, no odor; wet, firm.	CL SW CL		1161.4	0 0 0						
25	1160	10.5 - 12.0 SW - SAND, fine to coarse sand, dark brown, no odor; wet, loose.	SW CL		24.0 1160.5 24.9 1159.4	0 0 0 0	13	SS	2-2-2-2	4	2.0/2.0	
		12.0 - 12.2 CL - SILTY CLAY; some fine sand; brown, no odor; wet, soft.	CL CH		1158.9 1158.5	0 0 0 0	14	SS	2-2-3-4	5	1.3/2.0	
		12.2 - 14.0 CH - CLAY, high plasticity, grey, no odor; moist, soft to firm.	CL SC		26.9 1157.4 28.2							
		14.0 - 16.0 Shelby Tube pushed 14-16 ft bgs. (CLAY)	CL SC		1155.4 30.1	0 0 0 0	15	SS	3-2-5-4	7	1.0/2.0	
30	1155	16.0 - 17.2 SW - SAND, fine to coarse sand; trace fine subrounded gravel; brown, no odor; wet, loose (gradual increase in grain size with depth).	CL			0 0 0 0	16	SS	7-10-10-11	20	2.0/2.0	Filter Pack 24-37 ft bgs 0.010-Inch Slot Screen 27-37 ft bgs
		17.2 - 18.0 CH - CLAY, high plasticity, grey, no odor; moist, firm to stiff.				0 0 0 0	17	SS	3-3-4-5	7	1.0/2.0	
35	1150	18.0 - 18.8 CH - CLAY; trace fine subangular gravel; grey, no odor; wet, soft.			1149.4	0 0 0 0	18	SS	4-3-7-9	10	1.0/2.0	
		18.8 - 18.9 CH - CLAY, medium plasticity; some fine sand; grey-brown, no odor; wet, soft.	SP CL SP		1148.7 1147.8	0 0 0 0	19	SS	6-9-42-50/1	51	1.5/1.8	Bentonite Fill 37-37.6 ft bgs
		18.9 - 20.9 CH - CLAY; trace fine subangular gravel; grey, no odor; wet, soft (20.5-20.9: some fine sand).										
40	1145	20.9 - 21.0 CH - CLAY, high plasticity, grey, no odor; moist, firm.										

Log continued on next page

WELL CONSTRUCTION DETAILS

MW12-59
Borehole Diameter: 8-Inch
WELL CASING
Interval: 0-27 ft bgs
Material: PVC
Diameter: 2-Inch
Joint Type: Threaded
WELL SCREEN
Interval: 27-37 ft bgs
Material: PVC
Diameter: 2-Inch
Slot Size: 0.010-Inch
End Cap: Threaded
FILTER PACK
Interval: 24-37 ft bgs
Type: #2 Sand
Quantity: 13-feet
FILTER PACK SEAL
Interval: 22-24 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-22 ft bgs
Type: Bentonite/Cement Grout
Quantity: 22-feet

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

GA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/19/12

RECORD OF BOREHOLE MW12-59

SHEET 2 of 2

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 37.6 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/16/12
DATE COMPLETED: 7/16/12
WEATHER: Sunny

DATUM: Local
COORDS: N: 458,313.3 E: 2,444,780.8
GS ELEVATION: 1185.4 ft
TOC ELEVATION: 1187.3 ft
TEMPERATURE: 80's F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES MW12-59	WELL CONSTRUCTION DETAILS
45	1140	21.0 - 22.9 SW - SAND, fine to coarse sand; trace silt; brown, no odor; wet, loose (22-22.9 ft bgs: gradual increase in grain size).											
		22.9 - 23.1 CL - sandy CLAY, fine to coarse sand, grey-brown, no odor; wet, soft to firm.											
		23.1 - 23.3 SW - SAND, fine to coarse sand; trace silt; brown, no odor; wet, very loose.											
		23.3 - 24.0 CL - SILTY CLAY; trace fine to coarse sand; grey, no odor; moist to wet, soft.											
		24.0 - 24.9 SW - SAND, fine to coarse sand; trace silt; brown, no odor; wet, very loose.											
50	1135	24.9 - 26.0 CL - SILTY CLAY; trace fine subrounded to subangular gravel; medium plasticity, grey, no odor; wet, soft.											
		26.0 - 26.5 CL - sandy SILTY CLAY, fine sand, medium plasticity, grey-brown, no odor; wet, soft.											
		26.5 - 26.9 CH - CLAY; some subrounded gravel, grey, no odor; moist, soft.											
55	1130	26.9 - 28.0 CL - sandy SILTY CLAY, fine sand, medium plasticity, grey-brown, no odor; wet, soft.											
		28.0 - 28.2 SC - CLAYEY SAND, fine sand, grey-brown, no odor; wet, loose.											
		28.2 - 30.0 CL - SILTY CLAY; trace fine subangular gravel; grey, no odor; moist, soft to firm.											
60	1125	30.0 - 30.1 SC - CLAYEY SAND, fine sand, grey-brown, no odor; wet, loose.											
		30.1 - 36.0 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm (34-36: firm to stiff).											
		36.0 - 36.2 SP - SAND, fine to medium sand; trace silt; brown, no odor; wet, loose.											
65	1120	36.2 - 36.7 CL - SILTY CLAY; some fine subangular gravel; grey, no odor; moist, firm.											
		36.7 - 37.0 SP- weathered sandstone, fine sand, white-grey; moist.											
70	1115	37.0 - 37.6 SANDSTONE - crushed sandstone, white-grey (Refusal at 37.6 ft bgs).											
		Boring completed at 37.6 ft											
75	1110												
80	1105												

MW12-59
Borehole Diameter: 8-Inch
WELL CASING
Interval: 0-27 ft bgs
Material: PVC
Diameter: 2-Inch
Joint Type: Threaded
WELL SCREEN
Interval: 27-37 ft bgs
Material: PVC
Diameter: 2-Inch
Slot Size: 0.010-Inch
End Cap: Threaded
FILTER PACK
Interval: 24-37 ft bgs
Type: #2 Sand
Quantity: 13-feet
FILTER PACK SEAL
Interval: 22-24 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-22 ft bgs
Type: Bentonite/Cement Grout
Quantity: 22-feet

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

RECORD OF BOREHOLE MW12-60

SHEET 1 of 1

PROJECT: ROC SALEM
PROJECT NUMBER: 933-6154-005
DRILLED DEPTH: 19.2 ft
AZIMUTH: N/A
LOCATION: 1224 Benton Rd Salem, OH

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 750
DATE STARTED: 7/10/12
DATE COMPLETED: 7/10/12
WEATHER: Overcast

DATUM: Local
COORDS: N: 458,847.4 E: 2,445,154.0
GS ELEVATION: 1181.4 ft
TOC ELEVATION: 1183.4 ft
TEMPERATURE: 65 F

INCLINATION: -90
DEPTH W.L.:
ELEVATION W.L.:
DATE W.L.:
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 0.5 OL - Organic SILT, organics; trace fine angular gravel; dark brown; moist.	OL		1180.9 0.5	0 0					
	1180	0.5 - 4.0 ML - SILT, tan-dark brown mottling; no odor; non-cohesive, dry, firm to stiff.	ML			0 0	1	SS	5-7-8-9	15	1.7 2.0
					1177.4	N/A	2	SS	12-10-23-17	33	0.8 2.0
5		4.0 - 6.0 ML - sandy SILT, fine sand, light brown-grey-dark brown mottling, no odor; non-cohesive, moist, firm (5.1-6: sandy CLAYEY SILT).	ML		4.0 1175.4	0 0 0 0	3	SS	7-6-7-5	13	1.5 2.0
		6.0 - 6.3 ML - CLAYEY SILT, tan-grey mottling, no odor; moist, firm.	ML		1175.1 6.3	0 0					
	1175	6.3 - 10.3 SC - CLAYEY SAND, fine sand; trace fine gravel, dark brown; no odor; non-cohesive, moist, loose (8-10.0 ft bgs: some fine gravel; wet; 9.5-10.0 ft bgs: dense).	SC			0 0	4	SS	6-8-8-7	16	0.8 2.0
						0 0	5	SS	6-4-4-3	8	2.0 2.0
10		10.3 - 12.6 ML - SILT, tan, iron staining, no odor; non-cohesive, moist, firm.	ML		1171.1 10.3	0 0	6	SS	2-2-5-7	7	1.3 2.0
	1170				1168.8	0 0					
		12.6 - 12.9 SM - SILTY SAND, fine to medium sand, brown; no odor; moist, loose to compact (12.75-12.9 ft bgs: wet).	SM		1168.5 12.9	0 0	7	SS	9-12-10-12	22	1.3 2.0
		12.9 - 14.0 CL - SILTY CLAY, some fine subrounded gravel, tan, iron banding 1.2-1.3 ft bgs; moist, firm to stiff.	CL		1167.4 14.0	0 0					
15		14.0 - 16.7 CH - CLAY, high plasticity, grey, cohesive, wet, soft to firm.	CH			0 0	8	SS	1-3-5-9	8	0.7 2.0
	1165				1164.7	0 0					
		16.7 - 16.9 SP - SAND, fine sand, grey; moist, compact.	SP		1164.5 16.9	0 0	9	SS	11-10-8-9	18	2.0 2.0
		16.9 - 18.5 CL - SILTY CLAY; some fine sand; grey, non-cohesive, moist, compact.	CL		1162.9	0 0	10	SS	5-44-50/2	>94	1.2 1.2
		18.5 - 19.2 ML - weathered siltstone, iron staining 18.5-18.8 ft bgs (Refusal at 19.2 ft bgs).	ML		18.5 1162.2						
20		Boring completed at 19.2 ft									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

MW12-60

Bentonite/Cement Grout 0-6 ft bgs

Filter Pack Seal 6-8 ft bgs

Filter Pack 8-15 ft bgs

0.010-inch Slot Screen 10-15 ft bgs

Bentonite Fill 15-19.2 ft bgs

WELL CONSTRUCTION DETAILS

MW12-60
Borehole Diameter: 8-inch
WELL CASING
Interval: 0-10 ft bgs
Material: PVC
Diameter: 2-inch
Joint Type: Threaded
WELL SCREEN
Interval: 10-15 ft bgs
Material: PVC
Diameter: 2-inch
Slot Size: 0.010-inch
End Cap: Threaded
FILTER PACK
Interval: 8-15 ft bgs
Type: #2 Sand
Quantity: 7-feet
FILTER PACK SEAL
Interval: 6-8 ft bgs
Type: Bentonite
Quantity: 2-feet
ANNULUS SEAL
Interval: 0-6 ft bgs
Type: Bentonite/Cement Grout
Quantity: 6-feet

LOG SCALE: 1 in = 2.5 ft
DRILLING COMPANY: Frontz Drilling
DRILLER: Aaron

GA INSPECTOR: BAR
CHECKED BY: K.M.
DATE: 8/30/12

Golder Associates

AA BOREHOLE RECORD SALEM OH ROC BORING LOGS.GPJ GOLDER NJ-PA 05-24-06.GDT 9/18/12

APPENDIX B

GEOTECHNICAL LABORATORY TEST DATA

PHASE 1 GEOTECHNICAL LABORATORY TEST DATA

TABLE B-1
LABORATORY TESTING PROGRAM (PHASE 1 TESTING)
FORMER NEASE CHEMICAL SITE, SALEM, OHIO

SAMPLE INFORMATION			TEST				
Boring ID	Sample Number	Sample Depth (feet-bgs)	Moisture Content ASTM D2216	Atterberg Limits ASTM D4318	Sieve Analysis ASTM D422	Specific Gravity ASTM D854	Permeability ASTM D5084
SB-10-G02	G1A & G2A	0-8	X		X		
	G2B	5-8	X		X		
	G3A	14-16	X	X	X	X	
	G16	20-22	X		X		
SB-10-G03A & SB-10-G03B	G1	0-5	X	X	X	X	
	G2*	5-7	X		X		X
	G4	10-12	X	X	X		
	G4*	10-12	X	X	X	X	X
	G12	13.5-14	X		X		
SB-12-G12#	-	20-21	X				X
GW-11-02	SA-2*	15-16	X	X	X	X	X
GW-11-02	SA-3	15-20	X	X	X	X	
GW-11-02	SA-4	20-22	X	X	X		

Notes

1. Samples denoted with a " * " are thin-walled Shelby tube samples.
2. "-" denotes no sample number availabe.
2. "X" denotes laboratory test performed on referenced sample.
3. See Appendix A for Boring logs and Appendix B for Geotechnical Laboratory Test Data.
4. SB-10-G03A & SB-10-G03B are borings offset less than 1 foot from the original SB-10-G03 boring. Offset borings were performed to obtain additional samples of various layers for geotechnical lab testing purposes.
5. Sample denoted with a " # " is a remolded sample since an undisturbed sample could not be obtained .

TABLE B-2
LABORATORY TEST DATA (PHASE 1 TESTING)
FORMER NEASE CHEMICAL SITE, SALEM, OHIO

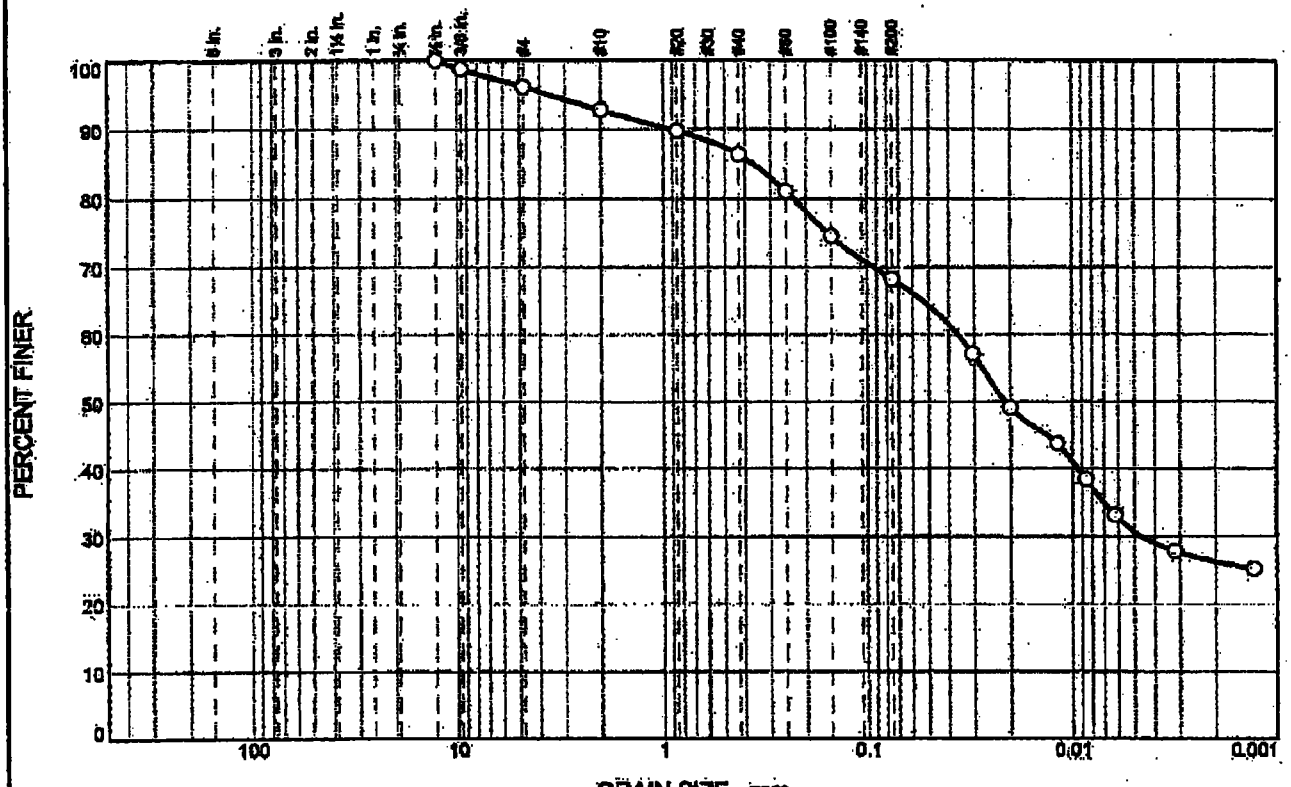
SAMPLE INFORMATION				TEST
Boring ID	Sample Number	Soil Type	Sample Depth (feet-bgs)	Permeability ASTM D5084 (cm/sec)
SB-10-G03A & SB-10-G03B	G2*	Sludge	5-7	4.07×10^{-5}
	G4*	Clay	10-12	1.35×10^{-7}
SB-12-G12#	-	Silty Sand	20-21	4.04×10^{-3}
GW-11-02	SA-2*	Clay	15-16	3.85×10^{-8}

Notes

1. Samples denoted with a " * " are thin-walled Shelby tube samples.
2. "-" denotes no sample number assigned.

See Section Phase 2 Geotechnical Laboratory Test Data
S/S/S Mix Design for Tables B-3, B-4, B-5

Particle Size Distribution Report



%:+3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.8	3.4	6.4	18.1	37.5	30.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	98.8		
#4	96.2		
#10	92.8		
#20	89.8		
#40	86.4		
#60	81.0		
#100	74.6		
#200	68.3		

* (no specification provided)

Material Description

Fill-Stab

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.9098 D_{85}= 0.3612 D_{60}= 0.0359
D_{50}= 0.0211 D_{30}= 0.0046 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 18.0%

Location: Salem, Ohio
Sample Number: SB-10-G02-G1A-G2A

Date: 06/16/2011

JLT Laboratories, Inc.

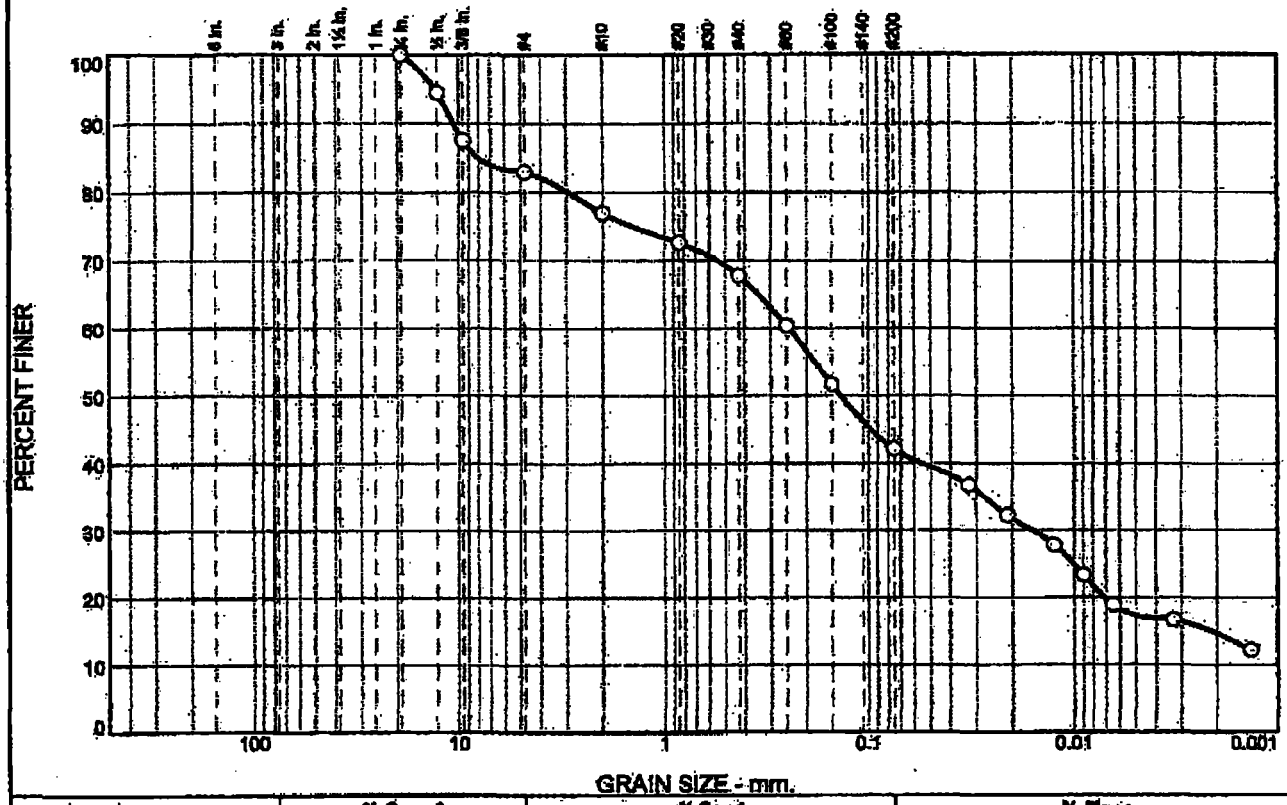
Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 101R2277.01

Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	17.1	5.9	9.2	25.6	24.9	17.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.50	94.5		
0.375	87.6		
#4	82.9		
#10	77.0		
#20	72.7		
#40	67.8		
#60	60.4		
#100	51.7		
#200	42.2		

* (no specification provided)

Material Description

Fill

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.5807 D_{85}= 8.0344 D_{60}= 0.2435
D_{50}= 0.1351 D_{30}= 0.0157 D_{15}= 0.0021
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 15.8%

Location: Salem, Ohio
Sample Number: SB10-G02-G2B

Date: 06/16/2011

JLT Laboratories, Inc.

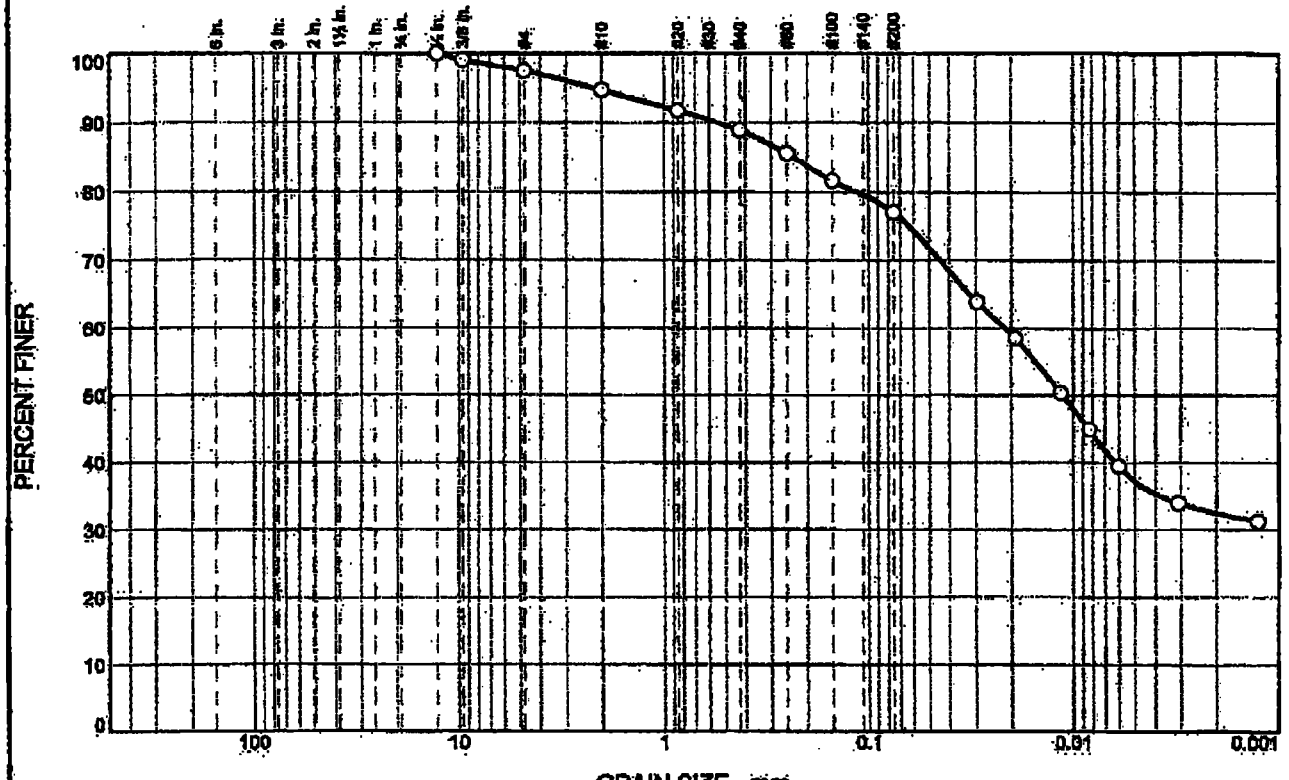
Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01

Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.4	2.9	5.8	11.9	39.8	37.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	99.1		
#4	97.6		
#10	94.7		
#20	91.7		
#40	88.9		
#60	85.6		
#100	81.6		
#200	77.0		

* (no specification provided)

Material Description

Clay

Atterberg Limits

PL= 18 LL= 22 PI= 4

Coefficients

D_{90}= 0.5354 D_{85}= 0.2326 D_{60}= 0.0213
D_{50}= 0.0112 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO=

Remarks

As-Rec'd M/C = 12.2%
Specific Gravity = 2.70

Location: Salem, Ohio
Sample Number: SB-10-G02-G3A 14-16'

Date: 06/16/2011

JLT Laboratories, Inc.

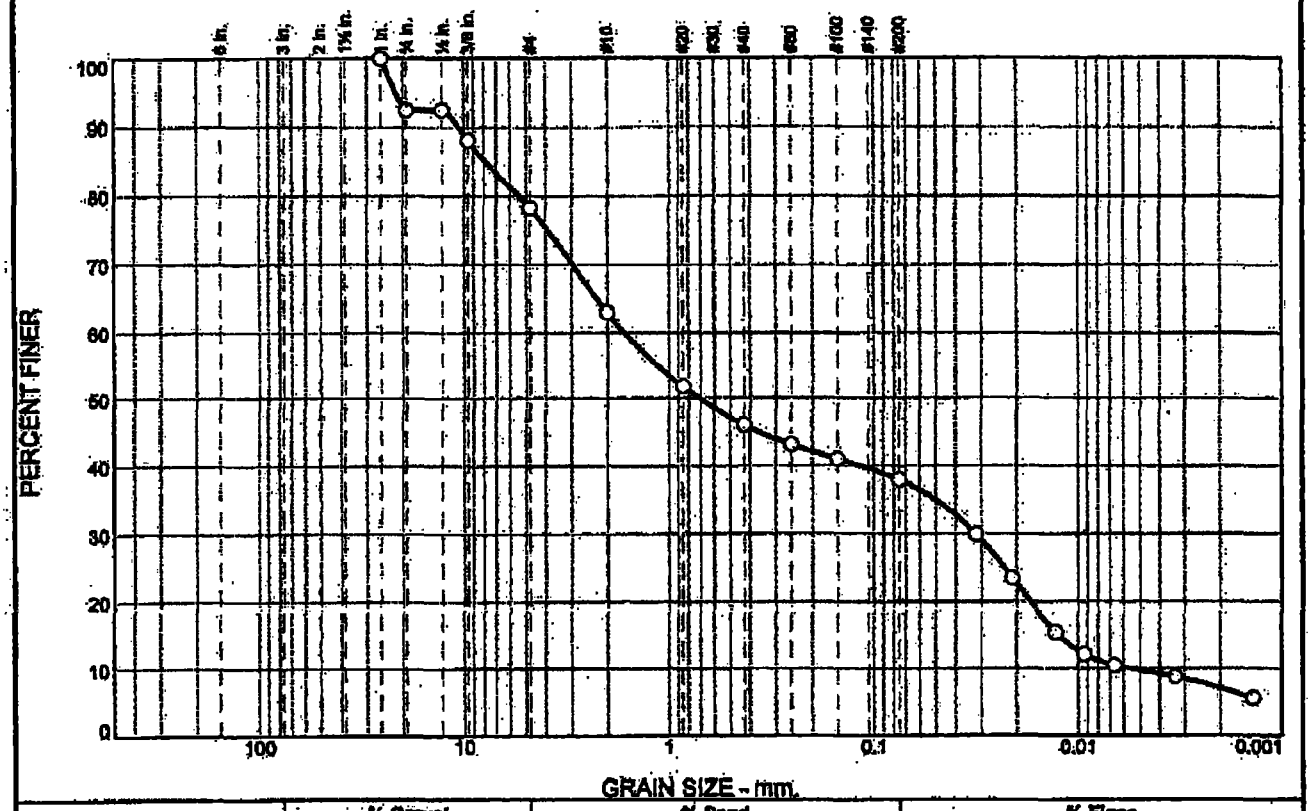
Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01

Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



%+3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	7.5	14.3	15.2	16.9	8.1	28.2	9.8

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.00	100.0		
0.75	92.5		
0.50	92.5		
0.375	88.1		
#4	78.2		
#10	63.0		
#20	51.7		
#40	46.1		
#60	43.2		
#100	41.0		
#200	38.0		

* (no specification provided)

Material Description

Contaminated Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 10.5587 D_{85}= 7.8969 D_{60}= 1.6536
D_{50}= 0.7068 D_{30}= 0.0319 D_{15}= 0.0125
D_{10}= 0.0055 C_u= 299.55 C_c= 0.11

Classification

USCS= SM AASHTO=

Remarks

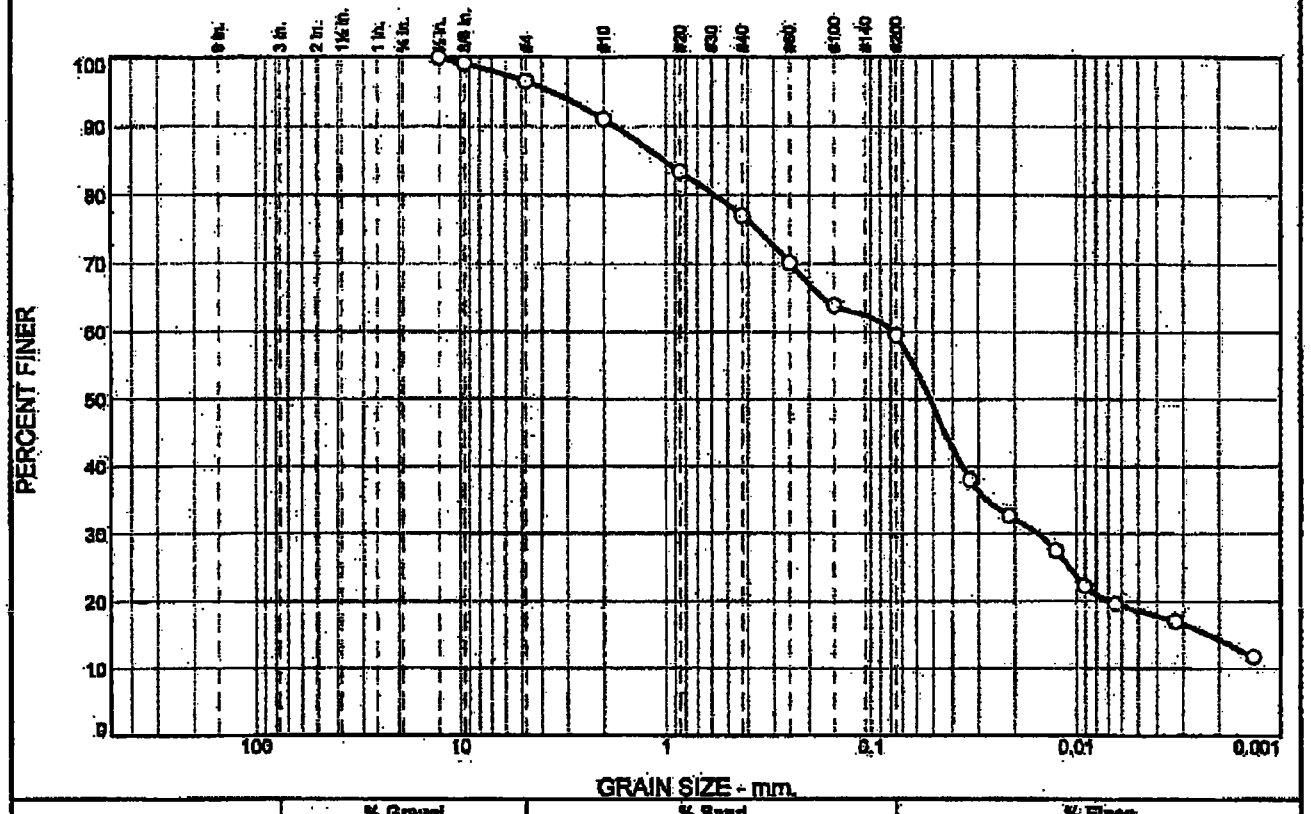
As-Rec'd M/C = 8.6%

Location: Salem, Ohio
Sample Number: SB-10G02-G16 Depth: 20 to 22 Date: 06/27/2011

JLT Laboratories, Inc.	Client: Golder Associates / Rutgers Organics
Canonsburg, PA	Project: Nease Chemical - ROC Salem, Ohio
	Project No: 11LR2277.02 Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.8	3.4	5.5	14.1	17.5	40.9	18.6

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	99.1		
#4	96.6		
#10	91.1		
#20	83.4		
#40	77.0		
#60	70.2		
#100	64.0		
#200	59.5		

* (no specification provided)

Material Description

SB-10-G03A & SB-10-G03B

Atterberg Limits

PL= 24 LL= 32 PI= 8

Coefficients

D_{90}= 1.7591 D_{85}= 1.0136 D_{60}= 0.0776
D_{50}= 0.0513 D_{30}= 0.0153 D_{15}= 0.0022
D_{10}= C_u= C_c=

Classification

USCS= ML-CL AASHTO=

Remarks

As-Rec'd M/C = 19.5%
Specific Gravity = 2.69

Location: Salem, Ohio
Sample Number: Fill Stab G1 (0-5')

Date: 06/15/2011

JLT Laboratories, Inc.

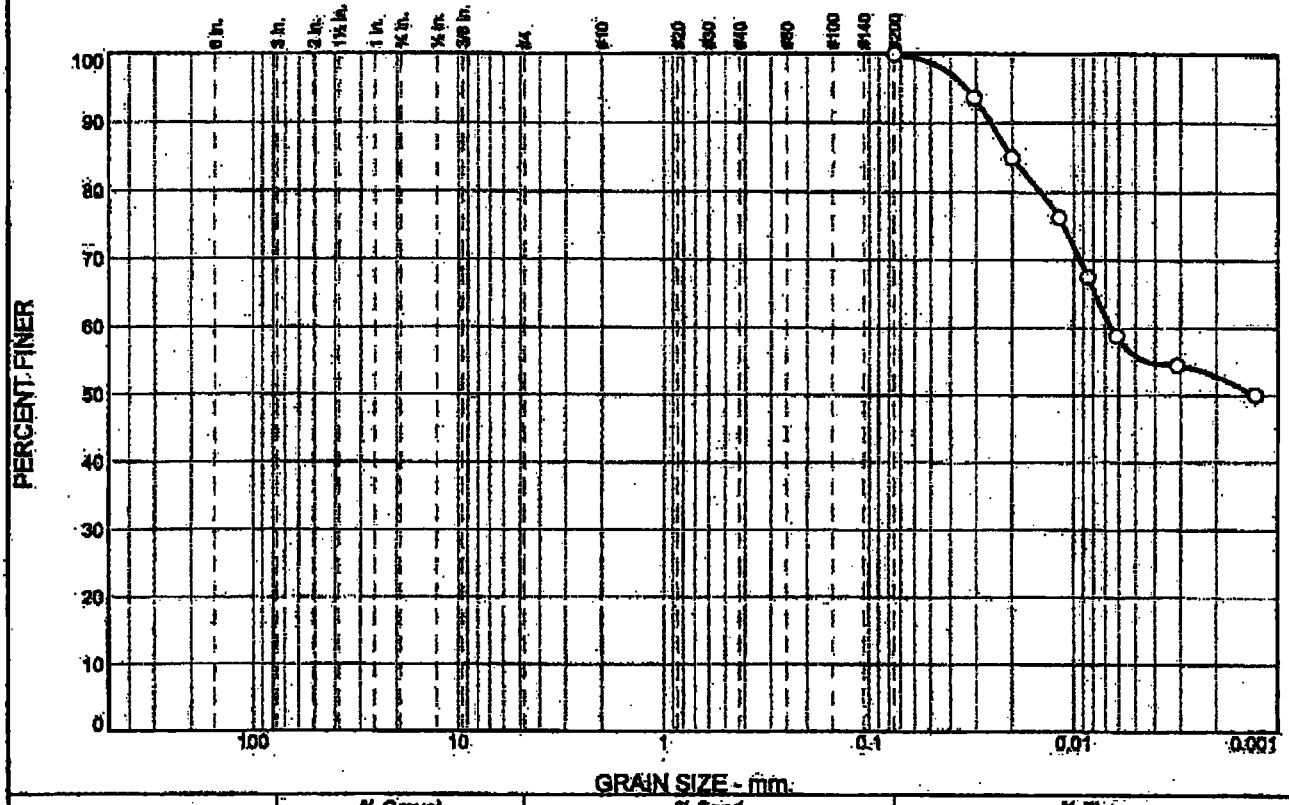
Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01

Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	0.0	0.0	0.0	0.0	44.1	55.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#200	100.0		

* (no specification provided)

Material Description

Shelby Tube - Sludge

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 0.0254 D_{85}= 0.0199 D_{60}= 0.0065
D_{50}= D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 90.0%

Location: Salem, Ohio
Sample Number: SB-10-GB03A-G2 Depth: 5 to 7 Date: 06/20/2011

JLT Laboratories, Inc. **Canonsburg, PA**	Client: Golder Associates / Rutgers Organics Project: Nease Chemical - ROC Salem, Ohio Project No: 10LR2277.01 Figure

Tested By: RL Checked By: JB

SUMMARY OF FLEX WALL PERMEABILITY TEST RESULTS
ASTM D-5084 (Method A)

JLT

Client	:	Golder / Rutgers Organic	Date	:	06/16/2011
Project Location	:	Nease Chemical, Salem, Ohio	Job No.	:	10LS2277.01
Sample Number	:	SB-10-GB03A-G2	Tested By	:	RL
		Shelby Tube - Porous Sludge	Checked By	:	JBJr
		5 to 7 feet			
Sample Date	:	Not Listed	Spec. Gravity	:	2.55 Assumed

Physical Property Data

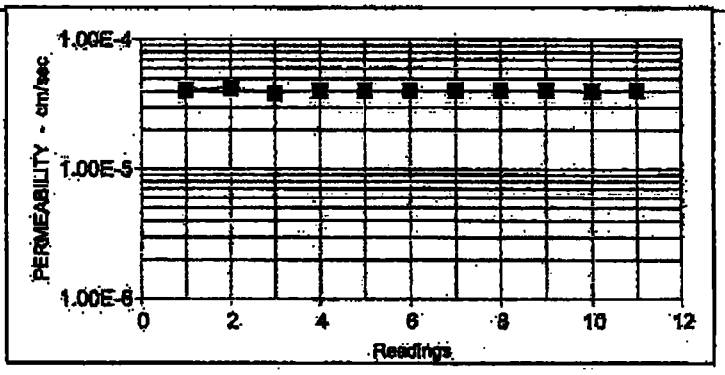
Initial Height (in)	:	4.00	Final Height (in)	:	3.90
Initial Diameter (in)	:	2.82	Final Diameter (in)	:	2.76
Initial Wet Weight (g)	:	583.70	Final Wet Weight (g)	:	572.00
Wet Density (pcf)	:	88.93	Wet Density (pcf)	:	93.17
Moisture Content %	:	87.68	Moisture Content %	:	83.92
Dry Density (pcf)	:	47.38	Dry Density (pcf)	:	50.66
Initial Void Ratio	:	2.3582	Final Void Ratio	:	2.1410
Saturation , %	:	94.8	Saturation , %	:	100.0

Test Parameters

Fluid		: De-Aired Water	Effective		
Cell Pressure psi)		: 65.00	Confining Pressure (psi)	:	10
Head Water psi)		: 56.80	Gradient	:	25.48
Tail Water psi)		: 53.20			

Permeability Input Data
For Last Data Point

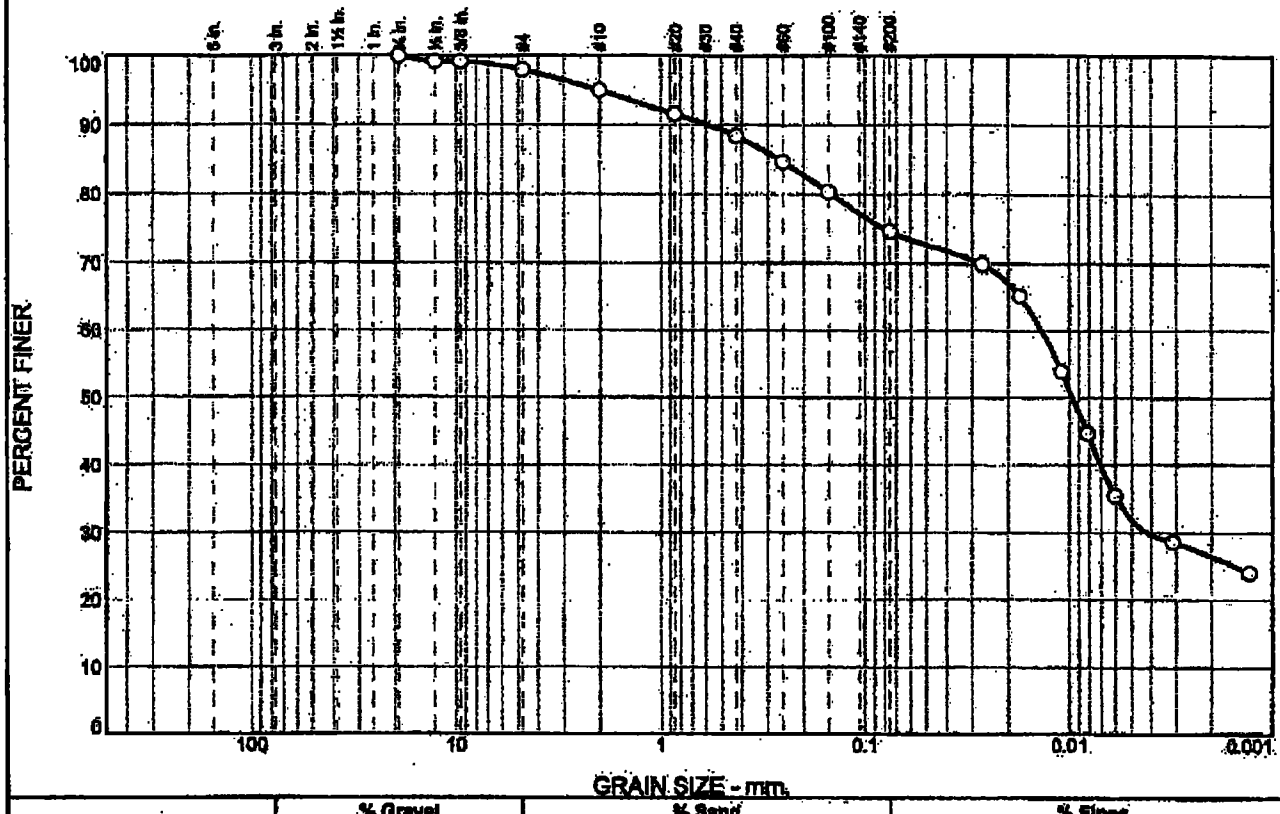
Flow, Q	(cc)	:	14.70
Length, L	(in)	:	3.90
Area, A	(sqin)	:	5.99
Head, h	(psi)	:	3.60
Time, t	(min)	:	6.00
Temp, T	(Deg C)	:	20.6



Computed Permeability

PERMEABILITY, K = 4.07E-005 (cm/sec) at 20 Degrees C

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.0	3.8	6.6	13.8	42.6	32.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.75	100.0		
0.50	99.2		
0.375	99.2		
#4	98.0		
#10	95.0		
#20	91.6		
#40	88.4		
#60	84.6		
#100	80.3		
#200	74.6		

(no specification provided)

Material Description

Composite

Atterberg Limits

PL= 24 LL= 32 PI= 8

Coefficients

D_{90}= 0.5822 D_{85}= 0.2621 D_{60}= 0.0136
D_{50}= 0.0096 D_{30}= 0.0041 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 24.6%

Location: Salem, Ohio
Sample Number: SB10-G03A-G4 **Depth:** 10 to 12' CS **Date:** 06/27/2011

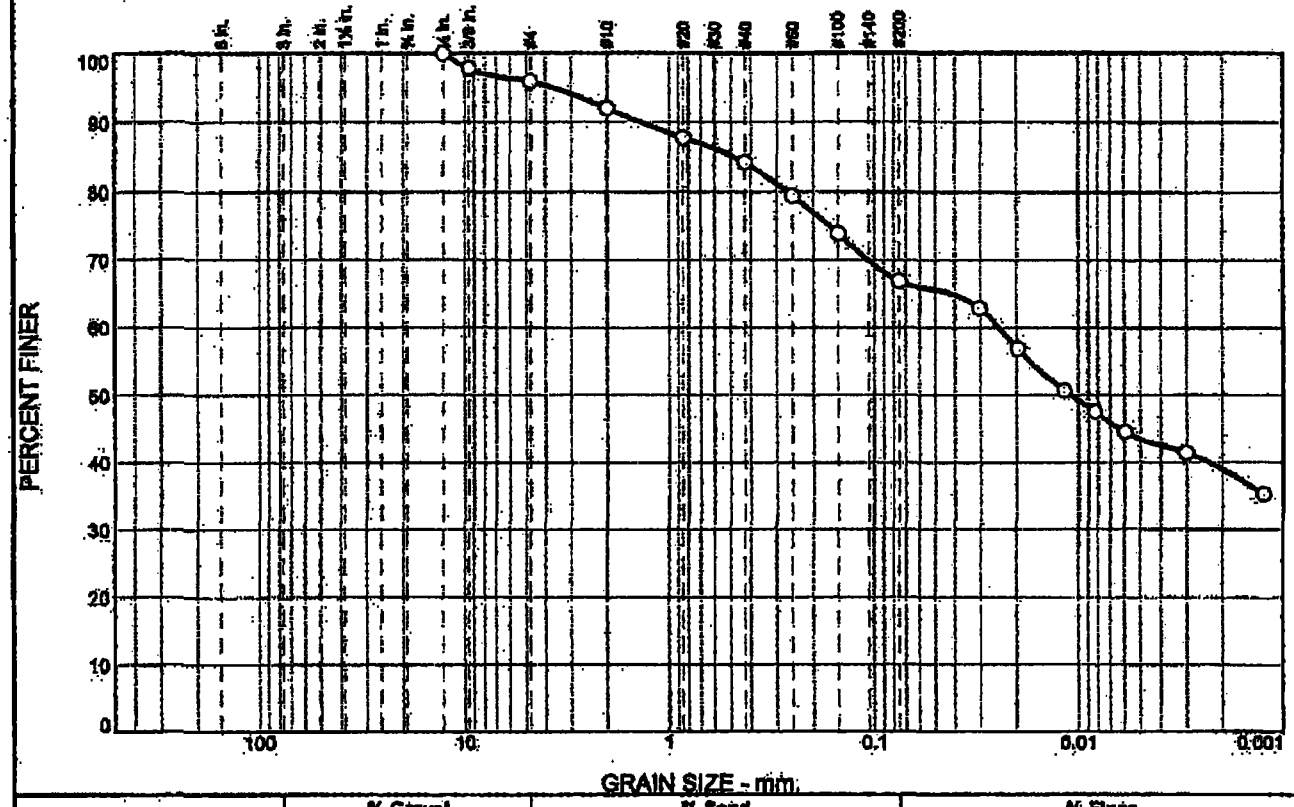
JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 11LR2277.02 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.1	3.9	7.8	17.3	23.4	43.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	97.8		
#4	95.9		
#10	92.0		
#20	87.8		
#40	84.2		
#60	79.4		
#100	73.9		
#200	66.9		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= 19 LL= 23 PI= 4

Coefficients

D_{90}= 1.3518 D_{85}= 0.4807 D_{60}= 0.0241
D_{50}= 0.0108 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 16.1%
Specific Gravity = 2.74

Location: Salem, Ohio
Sample Number: SB-10-GB-03B-G4 Depth: 10 to 12 Date: 06/20/2011

JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01 Figure

Tested By: RL Checked By: JB

SUMMARY OF FLEX WALL PERMEABILITY TEST RESULTS
ASTM D-5084 (Method A)

Client	: Golder / Rutgers Organic	Date	: 06/16/2011		
Project Location	: Nease Chemical, Salem, Ohio	Job No.	: 10LS2277.01		
Sample Number	: SB-10-GB-03B-G4	Tested By	: RL		
	Shelby Tube - Clay	Checked By	: JBJr		
	10 to 12 feet				
Sample Date	: Not Listed	Spec. Gravity	: 2.74	Assumed	

Physical Property Data

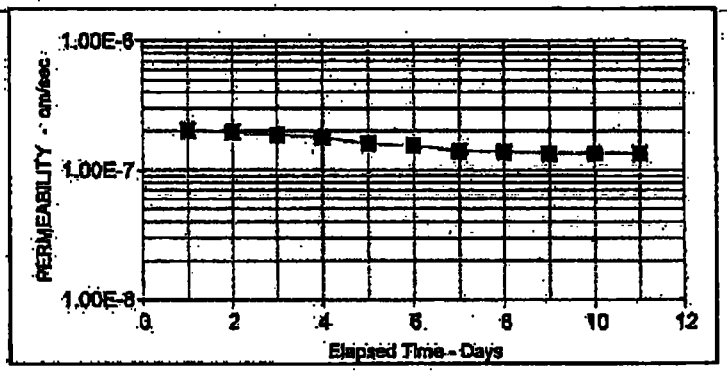
Initial Height (in)	:	4.00	Final Height (in)	:	3.97
Initial Diameter (in)	:	2.82	Final Diameter (in)	:	2.80
Initial Wet Weight (g)	:	895.10	Final Wet Weight (g)	:	886.10
Wet Density (pcf)	:	136.37	Wet Density (pcf)	:	138.46
Moisture Content %	:	16.78	Moisture Content %	:	15.59
Dry Density (pcf)	:	116.77	Dry Density (pcf)	:	119.79
Initial Void Ratio	:	0.4642	Final Void Ratio	:	0.4273
Saturation ,%	:	99.1	Saturation ,%	:	100.0

Test Parameters

Fluid	:	De-Aired Water	Effective		
Cell Pressure (psi)	:	65.00	Confining Pressure (psi)	:	10
Head Water (psi)	:	56.80	Gradient	:	25.03
Tail Water (psi)	:	53.20			

Permeability Input Data
For Last Data Point

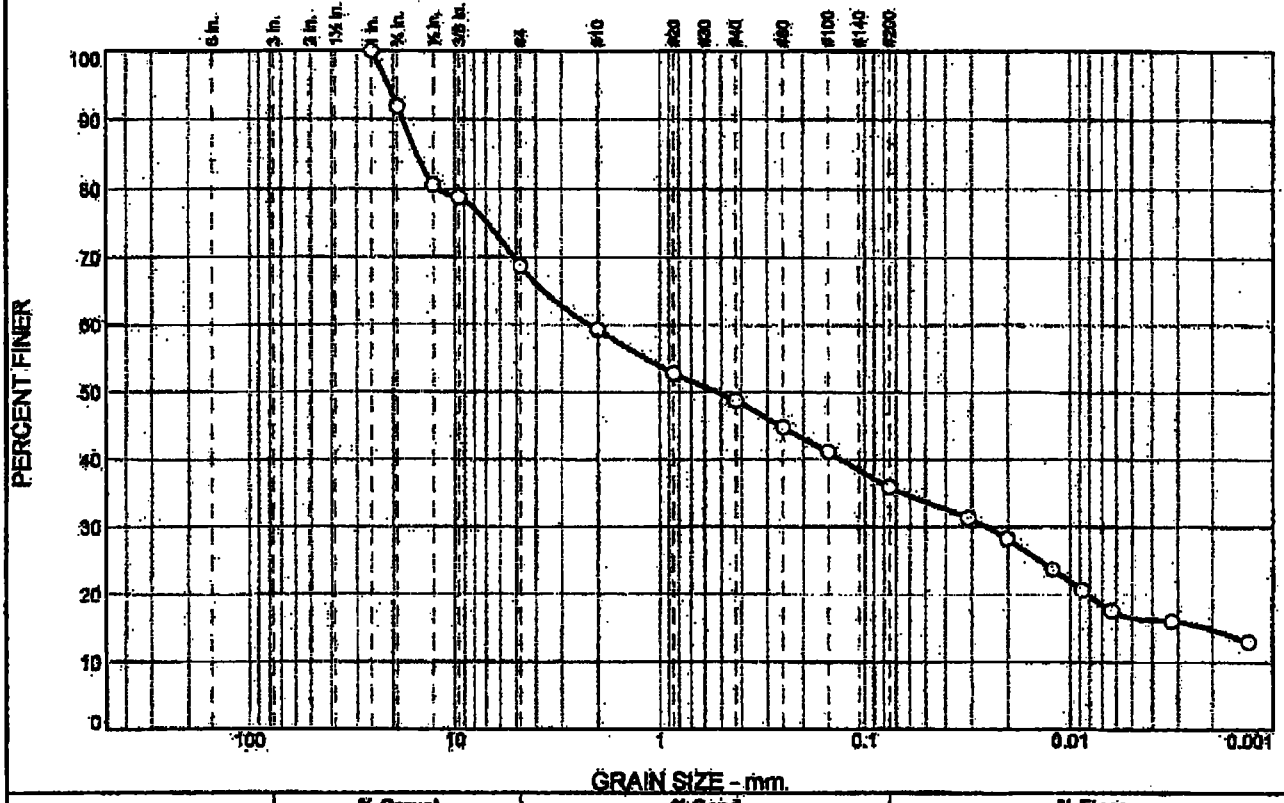
Flow, Q	(cc)	:	11.80
Length, L	(in)	:	3.97
Area, A	(sqin)	:	6.14
Head, h	(psi)	:	3.60
Time, t	(min)	:	1441.00
Temp, T	(Deg C)	:	20.6



Computed Permeability

PERMEABILITY, K = 1.35E-007 (cm/sec) at 20 Degrees C

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	8.1	23.1	9.5	10.5	12.8	19.5	16.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.00	100.0		
0.75	91.9		
0.50	80.5		
0.375	78.7		
#4	68.8		
#10	59.3		
#20	52.8		
#40	48.8		
#60	44.8		
#100	41.1		
#200	36.0		

* (no specification provided)

Material Description

PC Sand

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 17.9289 D_{85}= 15.3461 D_{60}= 2.1793
D_{50}= 0.5192 D_{30}= 0.0253 D_{15}= 0.0021
D_{10}= C_u= C_c=

Classification

USCS= SM AASHTO=

Remarks

As-Rec'd M/C = 10.5%

Location: Salem, Ohio
Sample Number: SB10-G03-G12 Depth: 13.5 to 14 Date: 06/27/2011

JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 11LR2277.02 Figure

Tested By: RL Checked By: JB

SUMMARY OF CONSTANT HEAD PERMEABILITY TEST RESULTS

ASTM D-2434 - 2.8 Inch Diameter Permeameter

JLT

Client	: Golder	Date	: 02/03/2012
Project Location	: Salem Project	Job No.	: 12LS2546.01
Description	: Silty Sand	Tested By	: RL
Sample ID	: SB-12-G12 20 to 21 feet	Checked By	: JB

Physical Property Data

Height	:	4.00 in	Sample No.	:	SB-12-G12	
Diameter	:	2.80 in	Replicate No.	:	N/A	
Weight	:	799.00 gr	Bearing Load (psf)	:	0	
Dry Density	:	112.45 pcf (*)	Water Content	:	9.8	%
			Maximum Dry Density	:	NA	pcf
			Optimum Moisture	:	NA	%

Permeability Input Data

			TRIAL 1	TRIAL 2	TRIAL 3	TRIAL 4
Head (1) : Top, cm			31.8	31.5	31.3	31.3
Head (2) : Bottom, cm			14.6	14.4	14.4	14.4
Delta H	in	:	6.77	6.73	6.65	6.65
Flow, Q	cc	:	86.00	84.50	84.00	84.00
Time, t	sec	:	240.00	240.00	240.00	240.00
Temp, T	Deg C	:	19.40	19.40	19.40	19.40
Length, L	in	:	3.00	3.00	3.00	3.00

Computed Permeability (@ 20 degrees C)

PERMEABILITY (cm/sec) :	4.07E-003	4.02E-003	4.04E-003	4.04E-003

AVERAGE PERMEABILITY : **4.04E-003** cm/sec

$$k = \frac{Q * L}{A * h * t} * \text{Temp. Correction Factor for 20 Degrees}$$

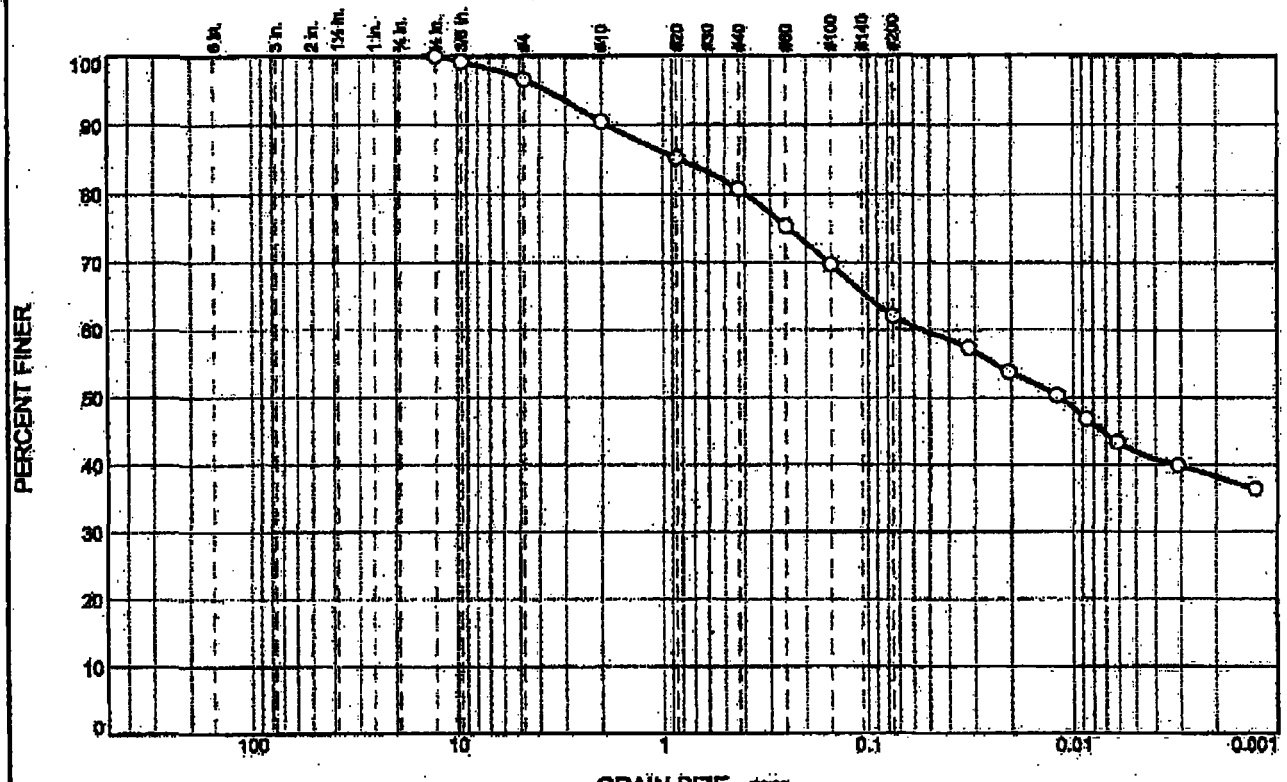
where:
- k = Permeability
- Q = Quantity of Flow
- L = Length of flow path
- A = Area of Sample
- H = Head Difference between Manometers
- t = Time of Flow, Q

Comments:

(*) Compacted as specified by Client
(Remolded SPT Sample)

JLT Laboratories, Inc. 938 S. Central Avenue, Canonsburg, Pa. 15317 Tel: 724-746-4441 Fax: 724-745-4261

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	3.4	6.1	9.7	18.6	20.2	42.0

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	99.2		
#4	96.6		
#10	90.5		
#20	85.2		
#40	80.8		
#60	75.4		
#100	69.8		
#200	62.2		

* (no specification provided)

Material Description

Shelby Tube

Atterberg Limits

PL= 15 LL= 20 PI= 5

Coefficients

D_{90}= 1.8595 D_{85}= 0.8128 D_{60}= 0.0529
D_{50}= 0.0115 D_{30}= D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML AASHTO=

Remarks

As-Rec'd M/C = 10.1%
Specific Gravity = 2.70

Location: Salem, Ohio
Sample Number: SA-2 Depth: 15 to 16 Date: 06/20/2011

JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01 Figure

Tested By: RL Checked By: JB

SUMMARY OF FLEX WALL PERMEABILITY TEST RESULTS
ASTM D-5084 (Method A)

JLT

Client	: Golder / Rutgers Organic		Date	: 06/16/2011	
Project Location	: Nease Chemical, Salem, Ohio		Job No.	: 10L52277.01	
Sample Number	: Sa - 2 (GW-11-02)		Tested By	: RL	
	Shelby Tube - Clay		Checked By	: JBJr	
	15 to 16 feet				
Sample Date	: 01/31/2011		Spec. Gravity	: 2.70	Assumed

Physical Property Data

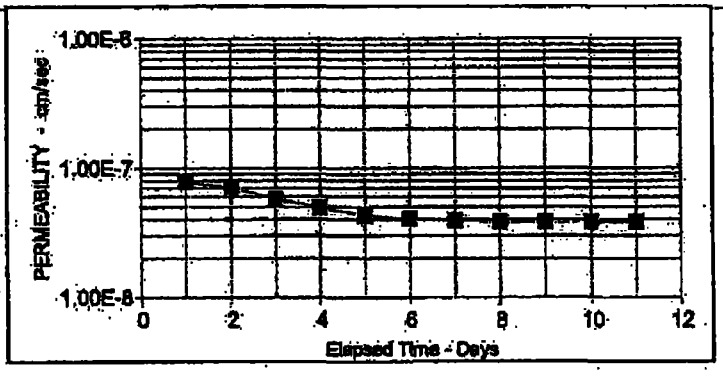
Initial Height (in)	:	3.55	Final Height (in)	:	3.50
Initial Diameter (in)	:	2.82	Final Diameter (in)	:	2.80
Initial Wet Weight (g)	:	765.30	Final Wet Weight (g)	:	762.90
Wet Density (pcf)	:	131.37	Wet Density (pcf)	:	134.74
Moisture Content %	:	17.75	Moisture Content %	:	17.39
Dry Density (pcf)	:	111.57	Dry Density (pcf)	:	114.78
Initial Void Ratio	:	0.5123	Final Void Ratio	:	0.4701
Saturation , %	:	93.7	Saturation , %	:	100.0

Test Parameters

Fluid	:	De-Aired Water	Effective		
Cell Pressure (psi)	:	65.00	Confining Pressure (psi)	:	10
Head Water (psi)	:	56.60	Gradient	:	25.23
Tail Water (psi)	:	53.40			

Permeability Input Data
For Last Data Point

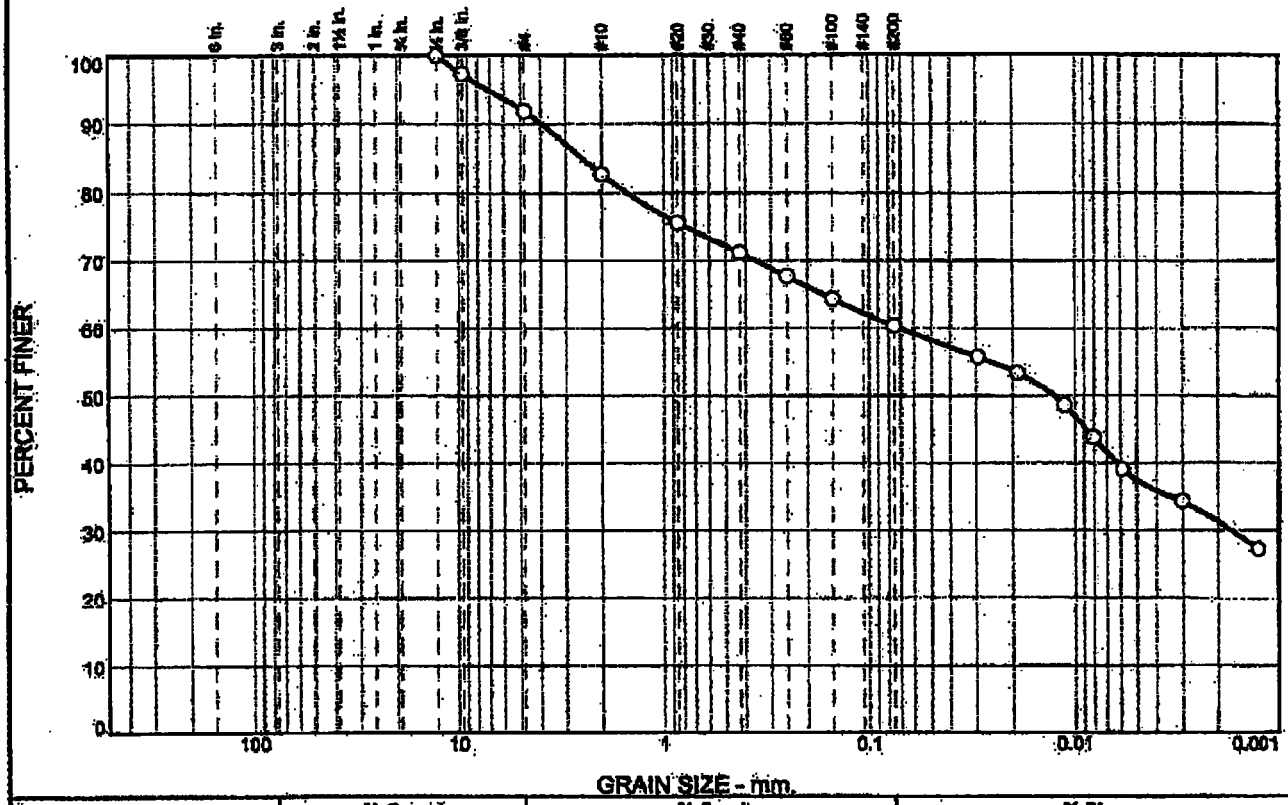
Flow, Q	(cc)	:	3.40
Length, L	(in)	:	3.50
Area, A	(sqin)	:	6.16
Head, h	(psi)	:	3.20
Time, t	(min)	:	1441.00
Temp, T	(Deg C)	:	20.6



Computed Permeability

PERMEABILITY, K = 3.85E-008 (cm/sec) at 20 Degrees C

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	8.1	9.2	11.5	10.8	22.9	37.5

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	97.3		
#4	91.9		
#10	82.7		
#20	75.6		
#40	71.2		
#60	67.7		
#100	64.4		
#200	60.4		

* (no specification provided)

Material Description

G11-02-SA-3-15-20
(GW-11-02)

Atterberg Limits

PL= 19 LL= 30 PI= 11

Coefficients

D_{90}= 3.9106 D_{85}= 2.4753 D_{60}= 0.0698
D_{50}= 0.0125 D_{30}= 0.0017 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= CL AASHTO=

Remarks

As-Rec'd M/C = 26.2%
Specific Gravity = 2.71

Location: Salem, Ohio
Sample Number: Impacted Clay 15-20'

Date: 06/15/2011

JLT Laboratories, Inc.

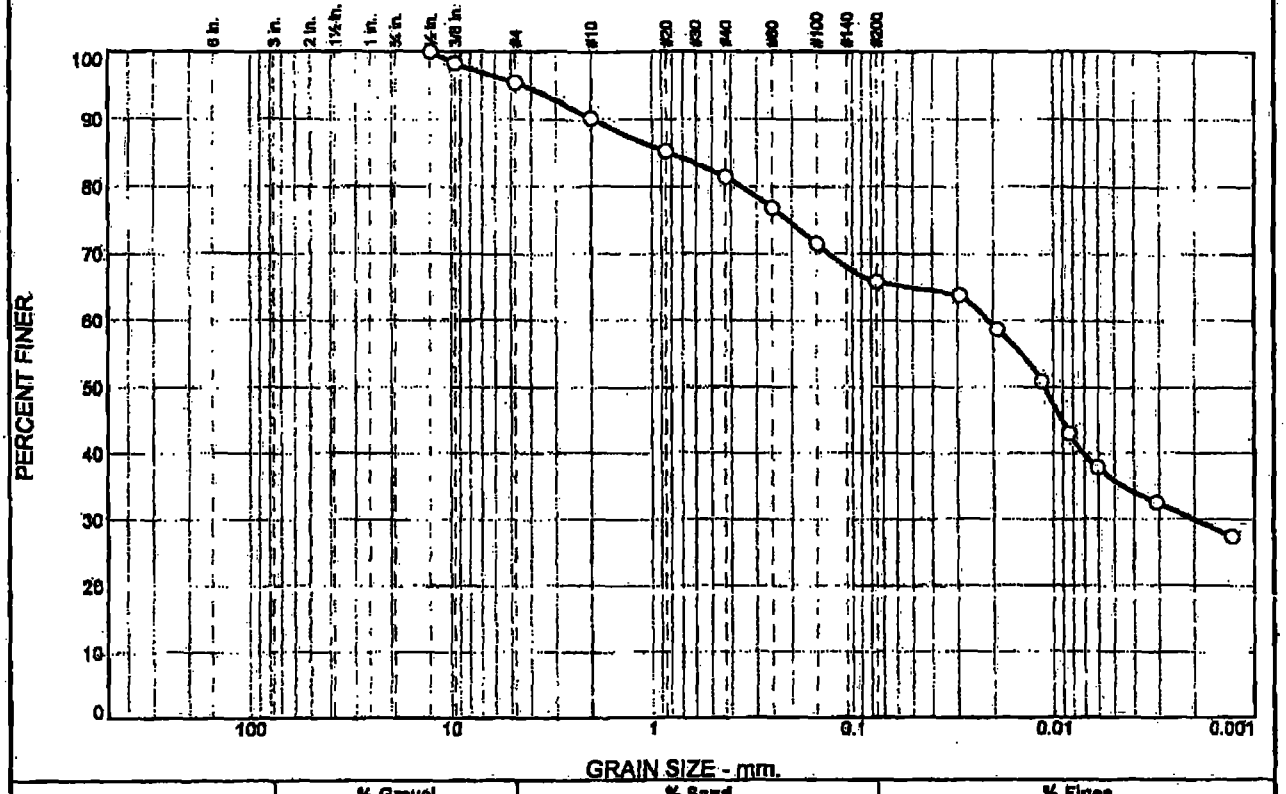
Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01

Figure

Tested By: RL Checked By: JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.6	5.3	8.7	15.5	30.0	35.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	98.3		
#4	95.4		
#10	90.1		
#20	85.2		
#40	81.4		
#60	76.8		
#100	71.5		
#200	65.9		

* (no specification provided)

Material Description

Impacted Soil

GW-11-02

Atterberg Limits

PL= LL= PI=

Coefficients

D_{90}= 1.9551 D_{85}= 0.8138 D_{60}= 0.0210
D_{50}= 0.0110 D_{30}= 0.0020 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

As-Rec'd M/C = 27.1%

Location: Salem, Ohio
Sample Number: SA-4 Depth: 20-22 Date: 06/16/2011

JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates / Rutgers Organics
Project: Nease Chemical - ROC
Salem, Ohio
Project No: 10LR2277.01 Figure

Tested By: RL Checked By: JB

ATTERBERG LIMITS DETERMINATION

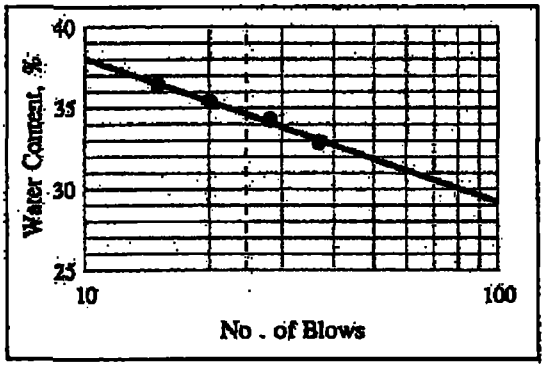
ASTM D-4318

JLT

CLIENT:	Golder Associates	JOB No.:	11LS2277.02
PROJECT:	Salem, Ohio	DATE OF TEST:	06/27/2011
SAMPLE ID:	SA 4 at 20 to 22 ft Impacted Soil GW-11-02	TESTED BY:	MLB
		CHECKED BY:	JBjr

LIQUID LIMIT DETERMINATION

Can No.	AT-127	AT-333	AT-26	AT-18	
Wt. of wet soil + can, g	11.1945	11.3893	13.7741	12.7246	
Wt. of dry soi	9.3586	9.5300	11.3622	10.6375	
Wt. of Can	4.3204	4.2820	4.3274	4.2946	
Wt. of dry soil, g	5.0382	5.2480	7.0348	6.3429	
Wt. of Moisture, g	1.8359	1.8593	2.4119	2.0871	
Water content, %	36.44	35.43	34.29	32.90	
No. of blows	15	20	28	37	



LIQUID LIMIT	=	35
PLASTIC LIMIT	=	23
PLASTICITY INDEX	=	12
CLASSIFICATION	=	

PLASTIC LIMIT DETERMINATION

Can No.	AT-501	AT-2			
Wt. of wet soil + can, g	5.0782	5.0966			
Wt. of dry so	4.9294	4.9456			
Wt. of Can,	4.2932	4.3008			
Wt. of dry soil, g	0.6362	0.6448			
Wt. of Moisture, g	0.1488	0.1510			
Water content, %	23.39	23.42			
Plastic Limit	23				

JLT Laboratories, Inc. 938 S. Central Ave, Canonsburg, Pa. Tel: 724-745-4441 Fax: 724-745-4261

PHASE 2 GEOTECHNICAL LABORATORY TEST DATA
S/S/S MIX DESIGN

TABLE B-3
LABORATORY TESTING PROGRAM FOR S/S/S MIX DESIGN (PHASE 2 TESTING)
FORMER NEASE CHEMICAL SITE, SALEM, OHIO

Boring ID	Sample Interval *(feet-bgs)*	Partial Interval for Specimen	Composite ID	Moisture Content	Sieve Analysis (with hydrometer)	Atterberg Limits	pH
				ASTM D2216	*ASTM D422*	*ASTM D4318*	*ASTM D4972*
SB-12-G09	4.0 - 8.0	n.a.	SSS-01	X	X	X	X
SB-12-G11	4.0 - 8.0	4.0 - 5.0					
SB-12-G15	4.0 - 8.0	4.0 - 4.5					
SB-12-G15	8.0 - 12.0	8.0 - 10.0					
SB-12-G14	8.0 - 12.0	n.a.	SSS-02	X	X	X	X
SB-12-G13	12.0 - 16.0	n.a.					
SB-12-G12	8.0 - 12.0	n.a.					
SB-12-G09	12.0 - 16.0	n.a.					
SB-12-G10 & G13	4.0 - 8.0	n.a.	SSS-03-01	X	X	X	X
SB-12-G10	8.0 - 12.0	8.0 - 10.0	SSS-03-02	X	X	X	X

TABLE B-4
LABORATORY TESTING PROGRAM FOR S/S/S MIX DESIGN (PHASE 2 TESTING)
FORMER NEASE CHEMICAL SITE, SALEM, OHIO

SAMPLE INFORMATION							TEST					
				Slurry			Unconfined Compression Strength				Permeability	
Boring ID	Sample Depth	Composite ID	Material	Treated Groundwater Added	Bentonite Added	Cement Added	7-day	10-day	14-day	28-day	Using Tap Water	Using Site Groundwater
	(feet-bgs)			(Litre)	(grams)	(% by soil wt)	ASTM D1633				ASTM D5084	ASTM D7100
SB-12-G09	4-8	SSS-01	Sludge	10	500	3, 6 and 12	X	X	X	X	X	X
SB-12-G11	4-8											
SB-12-G15	4-4.5											
SB-12-G15	0-13.5											
SB-12-G14	8-12	SSS-02	Clayey Silt	10	500	2, 4 and 8	X	X	X	X	X	X
SB-12-G13	12-16											
SB-12-G12	8-12											
SB-12-G09	12-16											

1. Permeability test was performed on selected composite samples based on results of unconfined compression strength test.
2. Site groundwater was recovered from monitoring well TW-06-14
3. ASTM D5084-10 Standard Test Methods for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter
4. ASTM D7100-11 Standard Test Method for Hydraulic Conductivity Compatibility Testing of Soils with Aqueous Solutions

Golder Associates

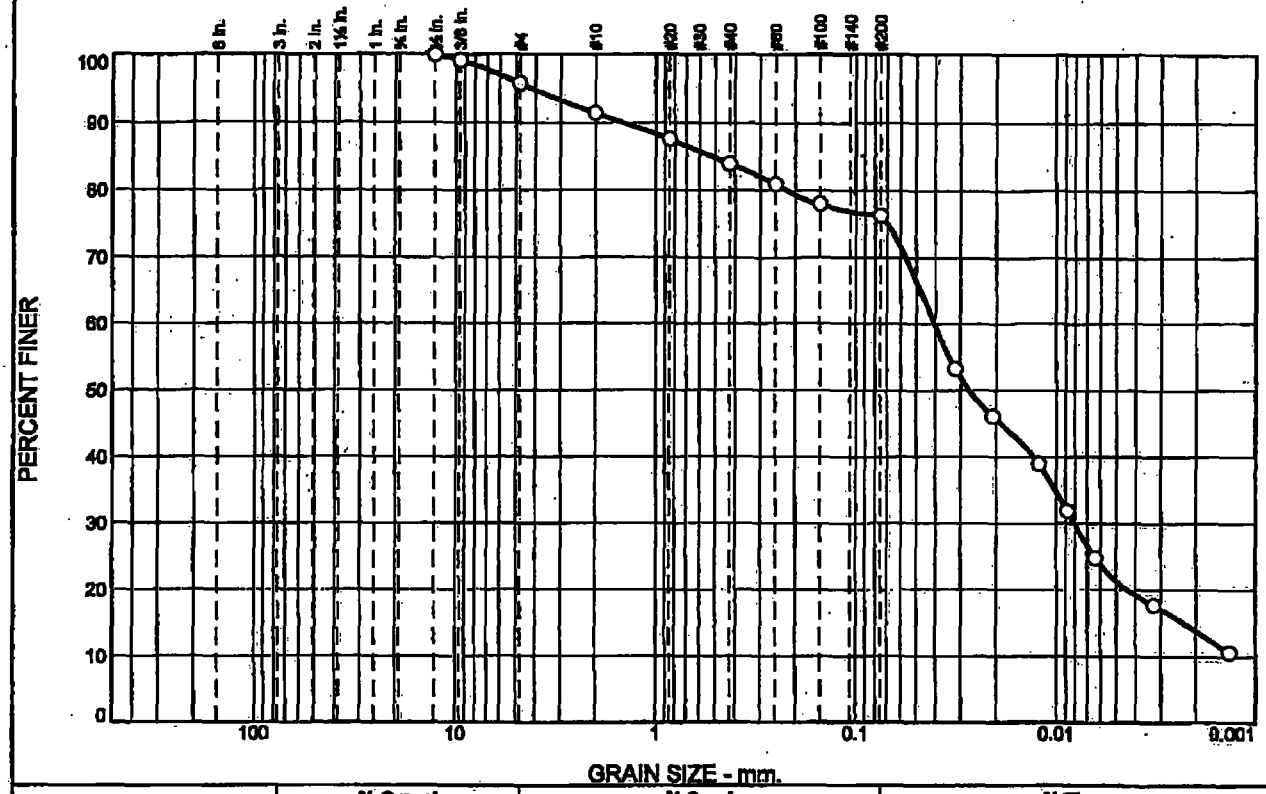
TABLE B-5
LABORATORY TEST DATA FOR S/S/S MIX DESIGN (PHASE 2 TESTING)
FORMER NEASE CHEMICAL SITE, SALEM, OHIO

SAMPLE INFORMATION			TEST					
Composite ID	Material	Cement Added	Unconfined Shear Strength				Permeability Test	
			7-day	10-day	14-day	28-day	Using Tap Water	Using Site Groundwater
		(% by soil wt)	(psi)				(cm/sec)	
SSS-1-1-3	Sludge	3	11.1	12.7	14.8	16.2	Not Tested	
SSS-1-2-6		6	46.2	64.9	76.2	86.6	$5.27x10^{-7}$	$2.76x10^{-7}$
SSS-1-3-12		12	105	188.1	239.9	268.7	Not Tested	
SSS-2-2-4	Clayey Silt	2	13.1	13.4	17	22	Not Tested	
SSS-2-1-2		4	22	27.1	31.8	40.1	$2.85x10^{-7}$	$1.01x10^{-7}$
SSS-2-3-8		8	29.3	37.2	40.5	56.3	Not Tested	

Golder Associates

Classification Test Data

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	4.2	4.4	7.5	7.6	55.0	21.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	99.2		
#4	95.8		
#10	91.4		
#20	87.5		
#40	83.9		
#60	80.9		
#100	78.0		
#200	76.3		

* (no specification provided)

Material Description

Waste Product
(Odor Similar to Kiwi Shoe Polish)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 1.4550 D_{85}= 0.5195 D_{60}= 0.0406
D_{50}= 0.0271 D_{30}= 0.0081 D_{15}= 0.0023
D_{10}= C_u= C_c=

Classification

USCS= N/A AASHTO=

Remarks

As-Rec'd M/C = 35.4%
pH = 6.23

Location: ROC Salem
Sample Number: SSS-01

Date: 04/09/2012

JLT Laboratories, Inc.

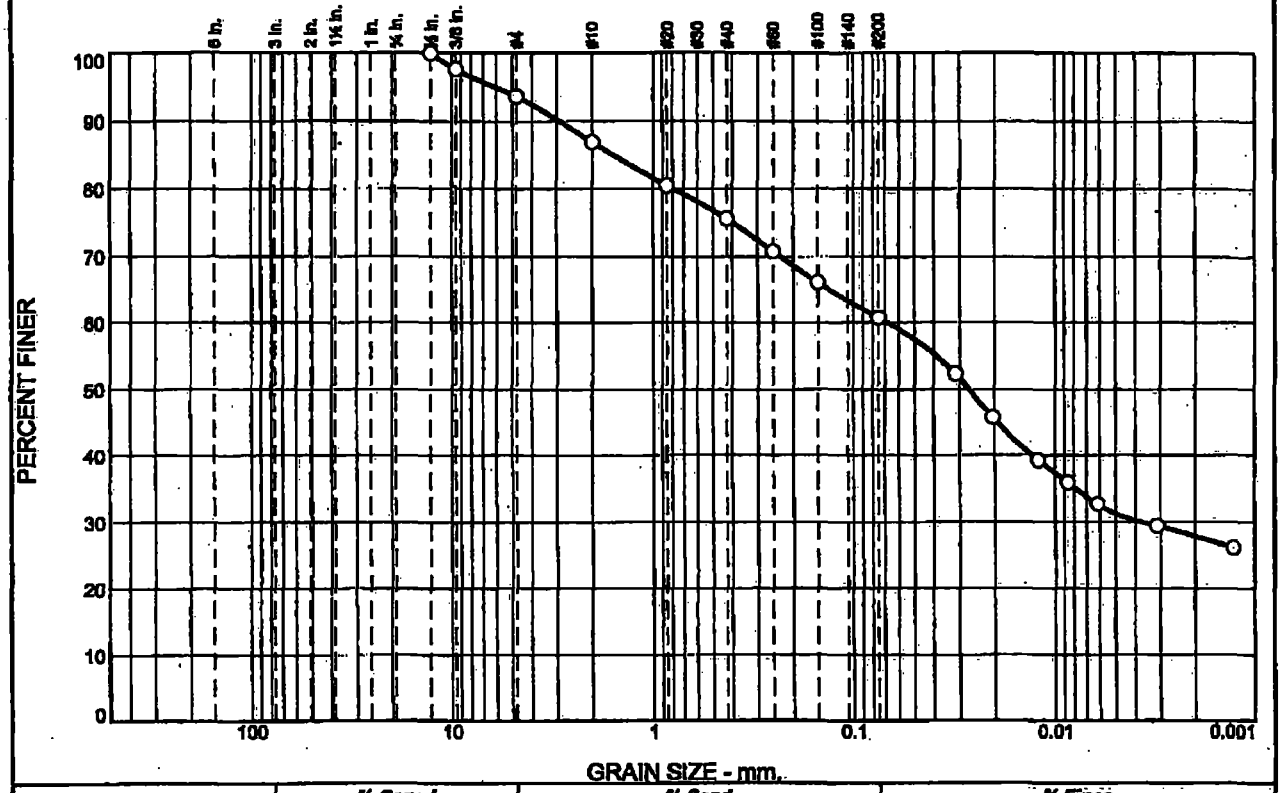
Canonsburg, PA

Client: Golder Associates
Project: ROC Salem

Project No: 12LS2546.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.4	6.7	11.3	14.8	29.5	31.3

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	97.7		
#4	93.6		
#10	86.9		
#20	80.5		
#40	75.6		
#60	70.7		
#100	66.2		
#200	60.8		

* (no specification provided)

Material Description

Brown Low Plastic Clayey Silt
Composite of Boring Samples

Atterberg Limits

PL= 21 LL= 26 PI= 5

Coefficients

D_{90}= 2.9044 D_{85}= 1.5765 D_{60}= 0.0677
D_{50}= 0.0268 D_{30}= 0.0037 D_{15}=
D_{10}= C_u= C_c=

Classification

USCS= ML-CL AASHTO=

Remarks

As-Rec'd M/C = 12.9%
pH = 6.42

Location: ROC Salem
Sample Number: SSS-02

Date: 04/09/2012

JLT Laboratories, Inc.

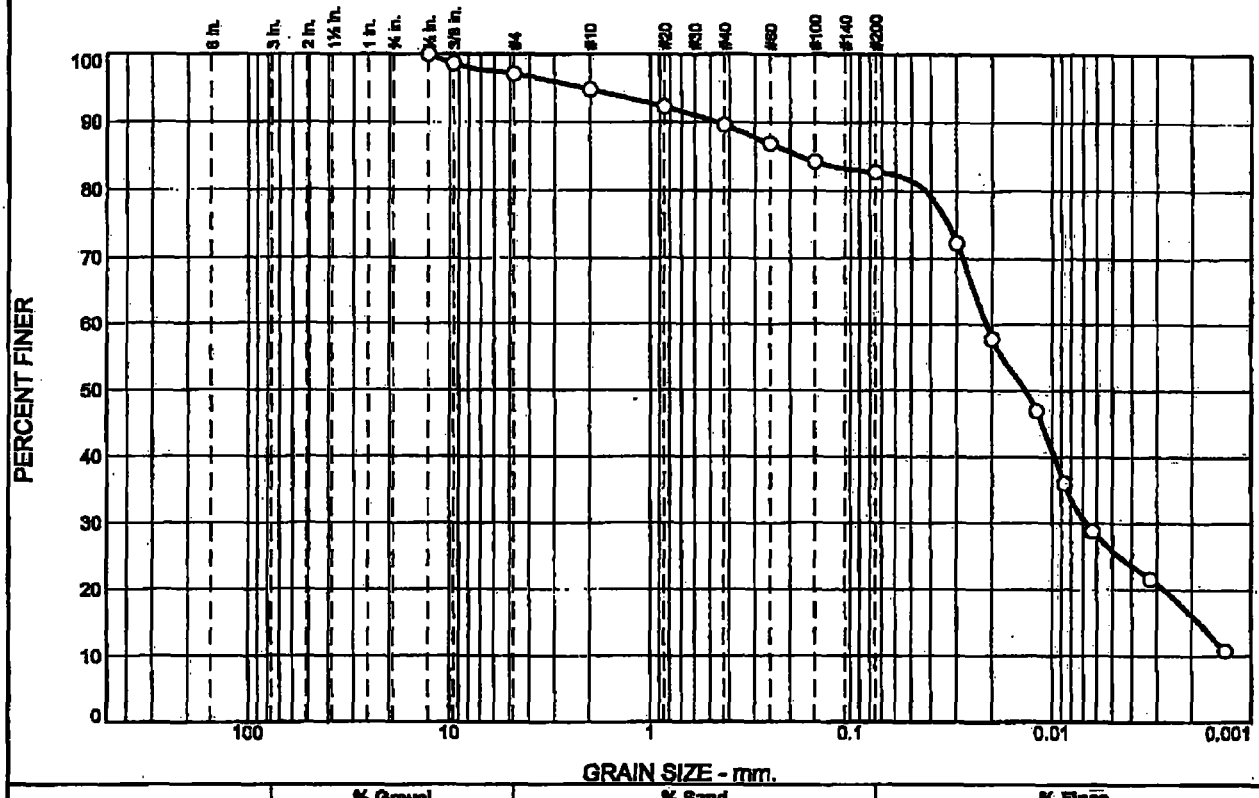
Canonsburg, PA

Client: Golder Associates
Project: ROC Salem

Project No: 12LS2546.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	2.8	2.3	5.3	6.9	56.8	25.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	98.6		
#4	97.2		
#10	94.9		
#20	92.3		
#40	89.6		
#60	86.9		
#100	84.3		
#200	82.7		

* (no specification provided)

Material Description

Waste Product
(Odor Similar to Kiwi Shoe Polish)

Atterberg Limits

PL= NP LL= NP PI= NP

Coefficients

D_{90}= 0.4620 D_{85}= 0.1761 D_{60}= 0.0213
D_{50}= 0.0135 D_{30}= 0.0067 D_{15}= 0.0018
D_{10}= C_u= C_c=

Classification

USCS= N/A AASHTO=

Remarks

As-Rec'd M/C = 44.5%
pH = 6.22

Location: ROC Salem
Sample Number: SSS-03-1

Date: 04/09/2012

JLT Laboratories, Inc.

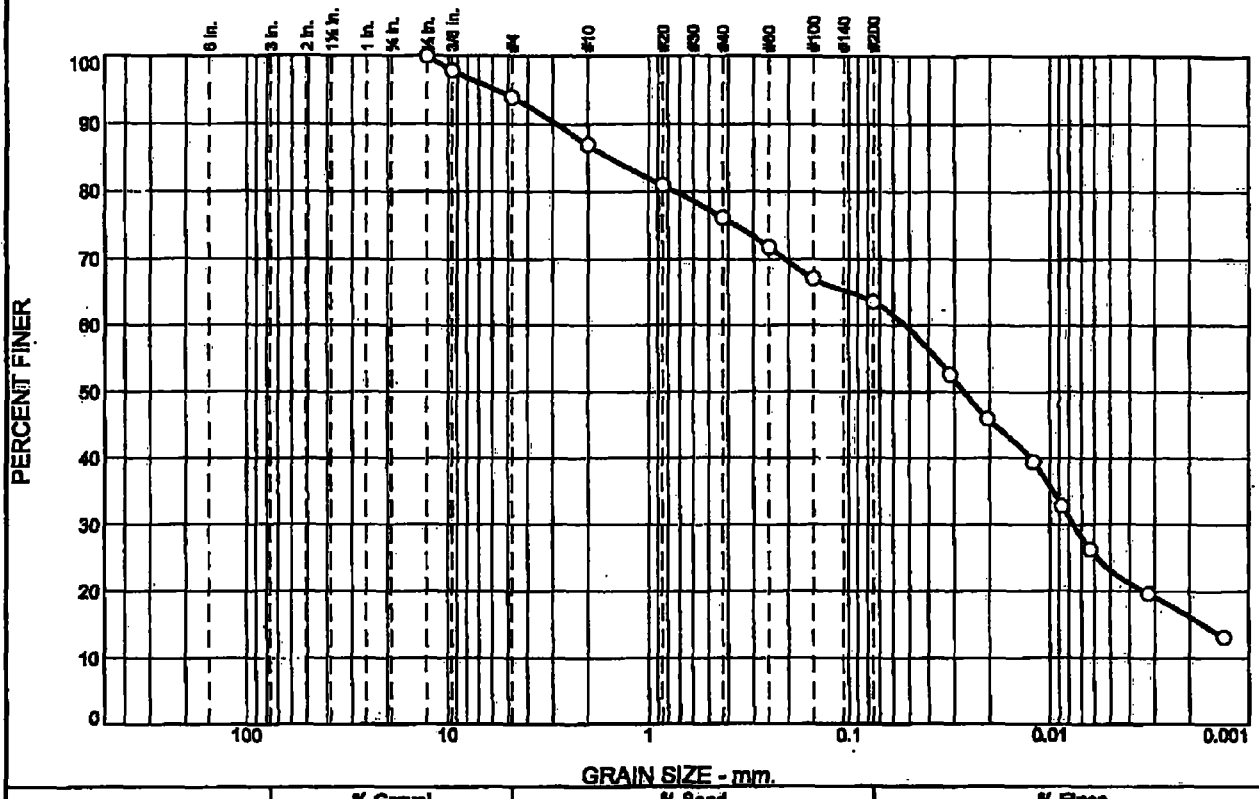
Canonsburg, PA

Client: Golder Associates
Project: ROC Salem

Project No: 12LS2546.01 **Figure**

Tested By: RL **Checked By:** JB

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	6.1	7.0	10.7	12.6	40.4	23.2

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
0.50	100.0		
0.375	97.9		
#4	93.9		
#10	86.9		
#20	80.9		
#40	76.2		
#60	71.8		
#100	67.1		
#200	63.6		

* (no specification provided)

Material Description

Brown Low Plastic Clayey Silt
Composite of Boring Samples

Atterberg Limits

PL= 23 LL= 30 PI= 7

Coefficients

D_{90}= 2.8793 D_{85}= 1.5510 D_{60}= 0.0524
D_{50}= 0.0267 D_{30}= 0.0076 D_{15}= 0.0017
D_{10}= C_u= C_c=

Classification

USCS= CL-ML AASHTO=

Remarks

As-Rec'd M/C = 17.3%
pH = 6.39

Location: ROC Salem
Sample Number: SSS-03-2

Date: 04/09/2012

JLT Laboratories, Inc.

Canonsburg, PA

Client: Golder Associates
Project: ROC Salem

Project No: 12LS2546.01 **Figure**

Tested By: RL **Checked By:** JB

Unconfined Compression Strength Test Data

JLT LABORATORIES, INC.
GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

July 17, 2012
12LS2277.03

Golder Associates, Inc.
200 Century Parkway
Suite 200
Mt Laurel, NJ 08054

Attn: Andrew Harpur

RE: COMPATIBILITY TEST RESULTS / SAMPLE SSS-1-2-6
STRENGTH TEST RESULTS / SAMPLES SSS-01 & SSS-02
ROC SALEM - NEASE CHEMICAL SITE (933-6154-50005)

Dear Mr. Harpur:

Submitted herein are the results of compatibility testing per ASTM D-7100 on mix sample SSS-1-2-6. The test commenced after 30 days of curing using groundwater identified as GW-TW-06-12. The test ran for a total of 52 days with no appreciable change in permeability. The results indicate the groundwater sample had no adverse effect on the sample. The Standard requires at least 2 pore volumes (3 inflow pore volumes) pass through the sample. For this test 3.86 pore volumes passed through the sample far exceeding the Standard for termination.

Unconfined Strength Tests
Also enclosed are the Unconfined Strength test results performed on six (6) mixes at 7, 10, 14 and 28 days for a total of twenty-four (24) Unconfined tests.

We appreciate the opportunity of being of service to you and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

Sincerely,

JLT LABORATORIES, INC.

John Boschuk, Jr., P.E., C.F.E.
President

cc: Rainer F. Domalski - Invoice Only

Enclosures
JB/mlb
\wp10\letter\12172
Invoice 4869

938 South Central Avenue • Canonsburg, Pennsylvania 15317 Tel: (724) 746-4441 Fax: (724) 745-4261

STRENGTH vs. CURING TIME

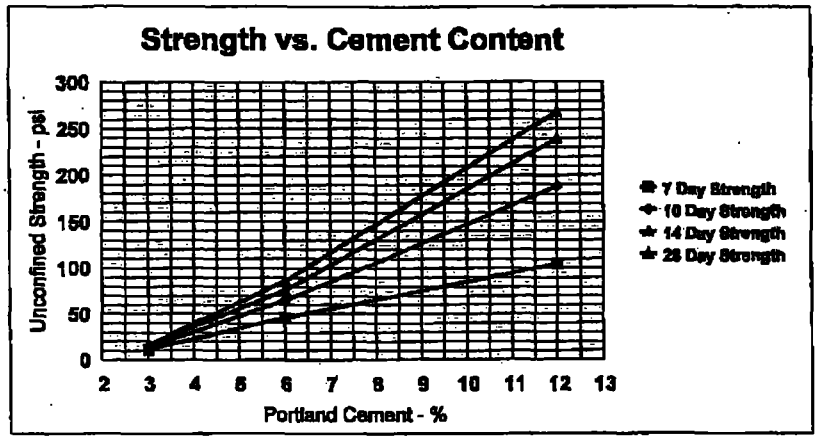
JLT

Client : Golder Associates
Project : Salem

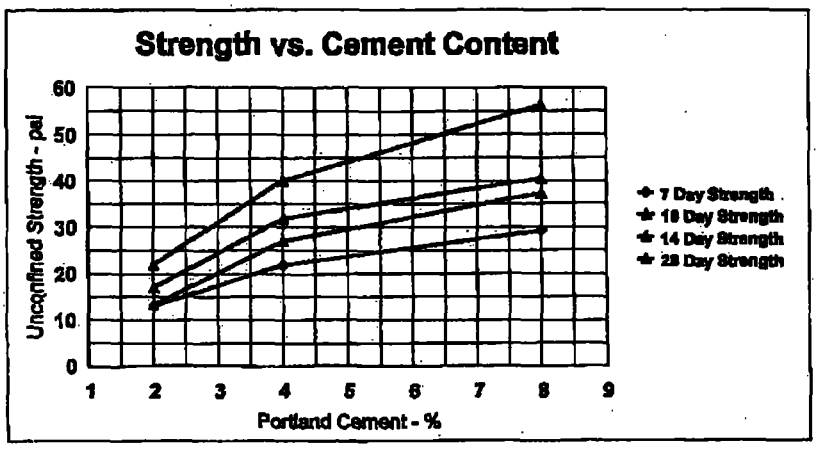
Print Date : 05/22/2012
Job No. : 11LS2277.03
Prep'd By : RL/JBJr
Chk'd By : JBJr

Unconfined Strength Requirement : > or = 15 psi in 28 Days **Date Fabricated : 04/24/2012**

BUCKET SSS-01 Sludge Material



BUCKET SSS-02 Clayey Silt Material



TRIAL MIX 7 DAY STRENGTH RESULTS

ASTM D-1633

JLT

Client : Golder Associates
Project : Salem

Print Date : 07/17/2012
Job No. : 11LS2277.03
Prep'd By : RL/JBJr
Chk'd By : JBJr

Date Fabricated : 04/24/2012
7 Day Test Date: 05/01/2012

BUCKET SSS-01 Sludge Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-1-1-3	342.3	2.00	4.00	103.7	35	11.1
SSS-1-2-6	360.0	2.00	3.98	109.0	145	46.2
SSS-1-3-12	335.9	2.00	4.00	101.7	330	105.0

BUCKET SSS-02 Clayey Silt Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-2-1-2	359.5	2.00	3.95	108.9	41	13.1
SSS-2-2-4	358.2	2.00	3.95	107.9	69	22.0
SSS-2-3-8	336.8	2.00	4.00	102.6	92	29.3

Curing Dates		Unconfined Strength Required
Fabrication :	04/24/2012	15 psi in 28 Days
3-Days :	04/27/2012	No Test
7-Days :	05/01/2012	Tested
10-Days :	05/04/2012	
14-Days :	05/08/2012	
21-Days :	05/15/2012	
28-Days :	05/22/2012	

TRIAL MIX 10 DAY STRENGTH RESULTS

ASTM D-1633

JLT

Client : Golder Associates
Project : Salem

Print Date : 05/04/2012
Job No. : 11L52277.03
Prep'd By : RL/JBJr
Chk'd By : JBJr

Date Fabricated : 04/24/2012
10 Day Test Date: 05/04/2012

BUCKET SSS-01 Sludge Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-1-1-3	330.7	2.00	3.95	101.4	40	12.7
SSS-1-2-6	342.7	2.00	4.00	103.8	204	64.9
SSS-1-3-12	340.1	2.00	4.00	103.0	591	188.1

BUCKET SSS-02 Clayey Silt Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-2-1-2	351.5	2.00	4.00	106.5	42	13.4
SSS-2-2-4	351.7	2.00	3.97	107.3	85	27.1
SSS-2-3-8	342.7	2.00	3.95	105.1	117	37.2

	Curing Dates	Unconfined Strength Required 15 psi in 28 Days
Fabrication :	04/24/2012	
3-Days :	04/27/2012	No Test
7-Days :	05/01/2012	Tested
10-Days :	05/04/2012	Tested
14-Days :	05/08/2012	
21-Days :	05/15/2012	
28-Days :	05/22/2012	

TRIAL MIX 14 DAY STRENGTH RESULTS

ASTM D-1633

JLT

Client : Golder Associates
Project : Salem

Print Date : 05/08/2012
Job No. : 11LS2277.03
Prep'd By : RL/JBJr
Chk'd By : JBJr

Date Fabricated : 04/24/2012
14 Day Test Date: 05/08/2012

BUCKET SSS-01 Sludge Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-1-1-3	392.3	1.99	3.95	121.5	46	14.8
SSS-1-2-6	339.9	1.99	4.01	103.7	237	76.2
SSS-1-3-12	339.7	1.99	3.95	105.2	746	239.9

BUCKET SSS-02 Clayey Silt Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-2-1-2	359.0	1.99	3.98	110.4	53	17.0
SSS-2-2-4	360.7	1.99	3.96	111.5	99	31.8
SSS-2-3-8	342.7	1.99	3.99	105.1	126	40.5

	Curing Dates	Unconfined Strength Required 15 psi in 28 Days
Fabrication :	04/24/2012	
3-Days :	04/27/2012	No Test
7-Days :	05/01/2012	Tested
10-Days :	05/04/2012	Tested
14-Days :	05/08/2012	Tested
21-Days :	05/15/2012	
28-Days :	05/22/2012	

TRIAL MIX 28 DAY STRENGTH RESULTS

ASTM D-1633

JLT

Client : Golder Associates
Project : Salem

Print Date : 05/22/2012
Job No. : 11LS2277.03
Prep'd By : RL/JBJr
Chk'd By : JBJr

Date Fabricated : 04/24/2012
28 Day Test Date: 05/22/2012

BUCKET SSS-01 Sludge Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-1-1-3	331.8	2.00	4.00	100.5	51	16.2
SSS-1-2-6	336.4	2.00	4.00	101.9	272	86.6
SSS-1-3-12	341.5	2.00	4.00	103.4	844	268.7

BUCKET SSS-02 Clayey Silt Material

Mix ID	Weight grams	Diameter inches	Height inches	Bulk Density pcf	Peak Strength lbs	Peak Stress psi
SSS-2-1-2	350.6	2.00	4.00	106.2	69	22.0
SSS-2-2-4	368.5	2.00	4.00	108.6	126	40.1
SSS-2-3-8	337.4	2.00	4.00	102.2	177	56.3

Curing Dates

Fabrication :	04/24/2012	
3-Days :	04/27/2012	No Test
7-Days :	05/01/2012	Tested
10-Days :	05/04/2012	Tested
14-Days :	05/08/2012	Tested
21-Days :	05/15/2012	No Test
28-Days :	05/22/2012	Tested

Unconfined Strength Required
15 psi in 28 Days

Short Term Permeability Test Data

JLT LABORATORIES, INC.

GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

RECEIVED

JUN - 4 2012

GOLDER-N.J.

May 31, 2012
12LS2277.03

Golder Associates, Inc.
200 Century Parkway
Suite 200
Mt Laurel, NJ 08054

Attn: Andrew Harpur

RE: GEOTECHNICAL TEST RESULTS
ROC SALEM - NEASE CHEMICAL SITE

Dear Mr. Harpur:

Submitted herein are the results of baseline permeability tests (ASTM D-5084) performed on two (2) mix samples identified as SSS-1-2-6 and SSS-2-2-4. Each sample was tested after 15 days of curing using tap water as the permeant to produce baseline permeability values. We are currently performing testing on duplicate samples using groundwater identified as GW-TW-06-14 per ASTM D-7100.

We appreciate the opportunity of being of service to you and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

Sincerely,

JLT LABORATORIES, INC.

John Boschuk, Jr., P.E., C.F.E.
President

cc: Rainer F. Domalski - Invoice Only

Enclosures
JB/mlb
\wp10letter\12112
Inv# 4797

938 South Central Avenue • Canonsburg, Pennsylvania 15317 Tel: (724) 746-4441 Fax: (724) 745-4261

SUMMARY OF FLEX WALL PERMEABILITY TEST RESULTS
ASTM D-5084 (Method A)

Client	:	Golder / Rutgers Organic	Date	:	05/30/2012
Project Location	:	Nease Chemical, Salem, Ohio	Job No.	:	12LS2277.03
Sample Number	:	SSS-1-2-6 Percent	Tested By	:	RL
Age at Test	:	15 Days	Checked By	:	JBJr
		Base Permeability with Water	Spec. Gravity	:	2.70 Assumed

Physical Property Data

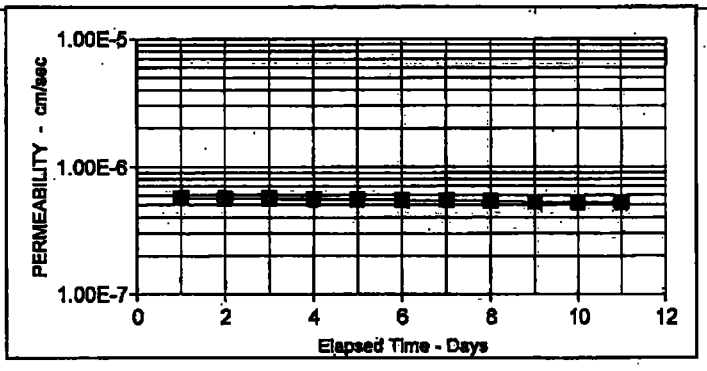
Initial Height (in)	:	3.96	Final Height (in)	:	3.97
Initial Diameter (in)	:	2.00	Final Diameter (in)	:	1.99
Initial Wet Weight (g)	:	340.10	Final Wet Weight (g)	:	346.60
Wet Density (pcf)	:	104.05	Wet Density (pcf)	:	106.84
Moisture Content %	:	48.71	Moisture Content %	:	51.46
Dry Density (pcf)	:	69.97	Dry Density (pcf)	:	70.54
Initial Void Ratio	:	1.4115	Final Void Ratio	:	1.3920
Saturation , %	:	93.3	Saturation , %	:	100.0

Test Parameters

Fluid	:	De-Aired Water	Effective		
Cell Pressure psi)	:	65.00	Confining Pressure (psi)	:	10
Head Water psi)	:	56.80	Gradient	:	25.03
Tail Water psi)	:	53.20			

Permeability Input Data
For Last Data Point

Flow, Q	(cc)	:	23.30
Length, L	(in)	:	3.97
Area, A	(sqin)	:	3.11
Head, h	**(psi)**	:	**3.60**
Time, t	(min)	:	1441.00
Temp, T	(Deg C)	:	20.6



Computed Permeability

PERMEABILITY, K = 5.27E-007 (cm/sec) at 20 Degrees C

SUMMARY OF FLEX WALL PERMEABILITY TEST RESULTS
ASTM D-5084 (Method A)

Client	:	Golder / Rutgers Organic	Date	:	05/30/2012
Project Location	:	Nease Chemical, Salem, Ohio	Job No.	:	12LS2277.03
Sample Number	:	SSS-2-2-4 Percent	Tested By	:	RL
Age at Test	:	15 Days	Checked By	:	JBJr
		Base Permeability with Water	Spec. Gravity	:	2.70 Assumed

Physical Property Data

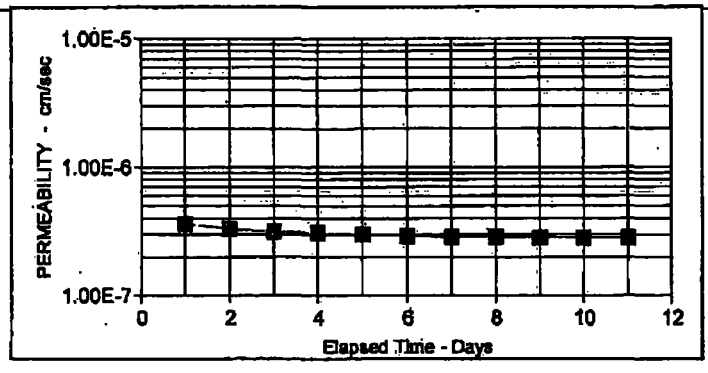
Initial Height (in)	:	3.95	Final Height (in)	:	3.94
Initial Diameter (in)	:	2.00	Final Diameter (in)	:	1.98
Initial Wet Weight (g)	:	354.00	Final Wet Weight (g)	:	356.30
Wet Density (pcf)	:	108.58	Wet Density (pcf)	:	112.35
Moisture Content %	:	40.92	Moisture Content %	:	41.76
Dry Density (pcf)	:	77.05	Dry Density (pcf)	:	79.26
Initial Void Ratio	:	1.1899	Final Void Ratio	:	1.1289
Saturation ,%	:	93.0	Saturation ,%	:	100.0

Test Parameters

Fluid	:	De-Aired Water	Effective		
Cell Pressure psi)	:	65.00	Confining Pressure (psi)	:	10
Head Water psi)	:	56.80	Gradient	:	25.22
Tail Water psi)	:	53.20			

Permeability Input Data
For Last Data Point

Flow, Q	(cc)	:	12.00
Length, L	(in)	:	3.94
Area, A	(sqin)	:	3.06
Head, h	(psi)	:	3.60
Time, t	(min)	:	1380.00
Temp, T	(Deg C)	:	20.6



Computed Permeability

PERMEABILITY, K = 2.85E-007 (cm/sec) at 20 Degrees C

Long Term Permeability Test Data

JLT LABORATORIES, INC.

GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

July 17, 2012
12LS2277.03

Golder Associates, Inc.
200 Century Parkway
Suite 200
Mt Laurel, NJ 08054

Attn: Andrew Harpur

RE: COMPATIBILITY TEST RESULTS / SAMPLE SSS-1-2-6
STRENGTH TEST RESULTS / SAMPLES SSS-01 & SSS-02
ROC SALEM - NEASE CHEMICAL SITE (933-6154-50005)

Dear Mr. Harpur:

Submitted herein are the results of compatibility testing per ASTM D-7100 on mix sample SSS-1-2-6. The test commenced after 30 days of curing using groundwater identified as GW-TW-06-12. The test ran for a total of 52 days with no appreciable change in permeability. The results indicate the groundwater sample had no adverse effect on the sample. The Standard requires at least 2 pore volumes (3 inflow pore volumes) pass through the sample. For this test 3.86 pore volumes passed through the sample far exceeding the Standard for termination.

Unconfined Strength Tests
Also enclosed are the Unconfined Strength test results performed on six (6) mixes at 7, 10, 14 and 28 days for a total of twenty-four (24) Unconfined tests.

We appreciate the opportunity of being of service to you and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

Sincerely,

JLT LABORATORIES, INC.

John Boschuk, Jr., P.E., C.F.E.
President

cc: Rainer F. Domalski - Invoice Only

Enclosures
JB/mlb
\\wp10\letter\12172
Inv# 4869

938 South Central Avenue • Canonsburg, Pennsylvania 15317 Tel: (724) 746-4441 Fax: (724) 745-4261

SUMMARY OF FLEX WALL COMPATIBILITY TEST RESULTS

ASTM D-7100 and EPA 9100 Compatibility Testing

Client	: GOLDER		Date	: 07/16/2012	
Project Location	: Salem		Job No.	: 11LS2277.03	
Description	: Mix SSS-1-2-6		Tested By	: RL / MLB	
Fabrication Date	: 04/24/2012		Checked By	: JBJr	
Start Date	: 05/24/2012		Panel No	: 15	
Age (Days)	: 30		Spec. Gravity	: 2.72	Assumed

Physical Property Data

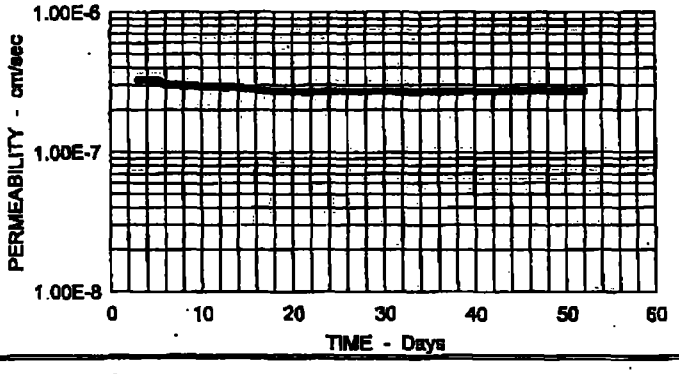
Initial Height (in)	:	3.99	Cut Height (in)	:	3.99
Initial Diameter (in)	:	2.00	Cut Diameter (in)	:	1.99
Initial Wet Weight (g)	:	339.90	Cut Wet Weight (g)	:	345.60
Wet Density (pcf)	:	103.21	Wet Density (pcf)	:	105.89
Moisture Content %	:	51.53	Moisture Content %	:	54.01
Dry Density (pcf)	:	68.11	Dry Density (pcf)	:	68.76
Initial Void Ratio	:	1.4919	Final Void Ratio	:	1.4686
Saturation , %	:	93.9	Saturation , %	:	100.0

Test Parameters

Fluid	:	GW-TW-06-12	Effective		
Cell Pressure (psi)	:	65.00	Confining Pressure (psi)	:	5
Head Water (psi)	:	61.80	Gradient	:	24.90
Tail Water (psi)	:	58.20			

Permeability Input Data
For Last Data Point

Flow, Q	(cc)	:	12.10
Length, L	(in)	:	3.99
Area, A	(sqin)	:	3.11
Head, h	(psi)	:	3.60
Time, t	(min)	:	1443.00
Temp, T	(Deg C)	:	20.4



Computed Permeability

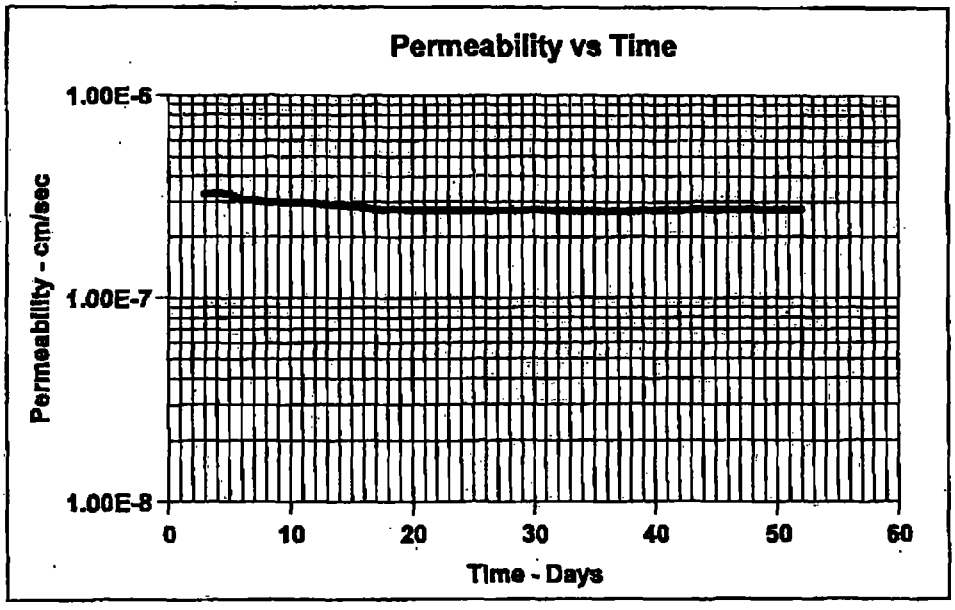
PERMEABILITY, K = 2.76E-007 (cm/sec) at 20 Degrees C

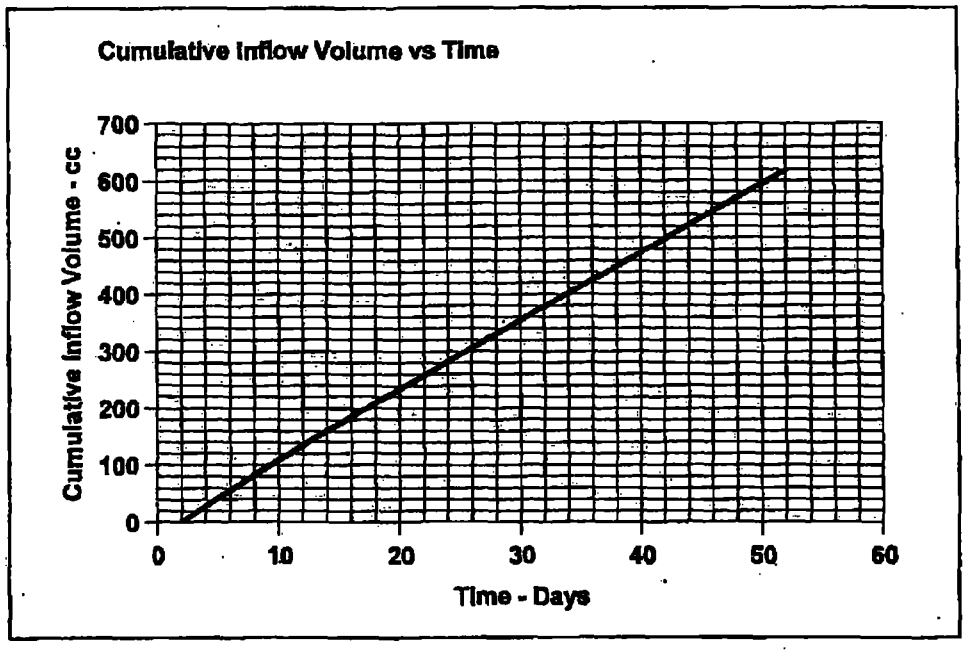
Day 52 **Total Inflow to Date : 619.3 cc**

Description : Mix SSS-1-2-6
Start Date : 05/24/2012

Permeant : GW-TW-08-12

Date : 07/16/2012
Computed Initial Pore Volume : 127.35 cc
Estimated Inflow Pore Volumes : 4.86





JLT Laboratories, Inc.

Client : GOLDER
Project Location : Salem
Description : Mix SSS-1-2-6
Start Date : 05/24/2012

Date : 07/16/2012
Job No. : 11LS2277.03
Tested By : RL / MLB
Checked By : JBJr

Initial Pore Volume : 127.35 cc
Final Pore Volume : cc

Elapsed Time Days	Permeability cm/sec	Inflow cc	Time minutes	Date	Total Cumulative Inflow, cc	Inflow Pore Volume	COMMENTS
1				05/24/2012	0.0	0	Start with Site Groundwater
2				05/25/2012	0.0	0.00	Consolidate two Days
3	3.31E-007	14.5	1442	05/26/2012	14.5	0.11	GW-TW-06-12
4	3.32E-007	14.5	1438	05/27/2012	29.0	0.23	
5	3.31E-007	14.5	1442	05/28/2012	43.5	0.34	
6	3.09E-007	13.5	1438	05/29/2012	57.0	0.45	Inflow and Outflow are Equal
7	3.09E-007	13.5	1440	05/30/2012	70.5	0.55	
8	3.02E-007	13.2	1442	05/31/2012	83.7	0.66	
9	3.02E-007	13.2	1439	06/01/2012	96.9	0.76	
10	3.00E-007	13.1	1440	06/02/2012	110.0	0.86	
11	3.00E-007	13.1	1439	06/03/2012	123.1	0.97	
12	2.97E-007	13.0	1441	06/04/2012	136.1	1.07	
13	2.92E-007	12.8	1442	06/05/2012	148.9	1.17	
14	2.93E-007	12.8	1439	06/06/2012	161.7	1.27	
15	2.87E-007	12.5	1437	06/07/2012	174.2	1.37	
16	2.86E-007	12.5	1439	06/08/2012	186.7	1.47	
17	2.76E-007	12.1	1444	06/09/2012	198.8	1.56	
18	2.77E-007	12.1	1438	06/10/2012	210.9	1.66	
19	2.77E-007	12.1	1439	06/11/2012	223.0	1.75	
20	2.74E-007	12.0	1440	06/12/2012	235.0	1.85	
21	2.74E-007	12.0	1441	06/13/2012	247.0	1.94	
22	2.74E-007	12.0	1440	06/14/2012	259.0	2.03	
23	2.74E-007	12.0	1441	06/15/2012	271.0	2.13	
24	2.74E-007	12.0	1442	06/16/2012	283.0	2.22	
25	2.75E-007	12.0	1438	06/17/2012	295.0	2.32	
26	2.75E-007	12.0	1439	06/18/2012	307.0	2.41	
27	2.74E-007	12.0	1443	06/19/2012	319.0	2.50	
28	2.75E-007	12.0	1439	06/20/2012	331.0	2.60	
29	2.74E-007	12.0	1442	06/21/2012	343.0	2.69	
30	2.75E-007	12.0	1437	06/22/2012	355.0	2.79	
31	2.75E-007	12.0	1439	06/23/2012	367.0	2.88	
32	2.72E-007	11.9	1443	06/24/2012	378.9	2.98	
33	2.73E-007	11.9	1438	06/25/2012	390.8	3.07	
34	2.72E-007	11.9	1440	06/26/2012	402.7	3.16	
35	2.72E-007	11.9	1442	06/27/2012	414.6	3.26	
36	2.72E-007	11.9	1441	06/28/2012	426.5	3.35	
37	2.72E-007	11.9	1439	06/29/2012	438.4	3.44	
38	2.72E-007	11.9	1439	06/30/2012	450.3	3.54	
39	2.74E-007	12.0	1442	07/01/2012	462.3	3.63	
40	2.74E-007	12.0	1441	07/02/2012	474.3	3.72	
41	2.74E-007	12.0	1440	07/03/2012	486.3	3.82	
42	2.74E-007	12.0	1442	07/04/2012	498.3	3.91	
43	2.77E-007	12.1	1441	07/05/2012	510.4	4.01	
44	2.77E-007	12.1	1438	07/06/2012	522.5	4.10	
45	2.77E-007	12.1	1439	07/07/2012	534.6	4.20	
46	2.77E-007	12.1	1438	07/08/2012	546.7	4.29	
47	2.77E-007	12.1	1440	07/09/2012	558.8	4.39	
48	2.77E-007	12.1	1441	07/10/2012	570.9	4.48	
49	2.77E-007	12.1	1440	07/11/2012	583.0	4.58	
50	2.76E-007	12.1	1442	07/12/2012	595.1	4.67	
51	2.77E-007	12.1	1441	07/13/2012	607.2	4.77	

52	2.76E-007	12.1	1443	07/14/2012	619.3	4.86	Test Terminated
			Initial pH inflow = 7.9				Page 2
			Final pH outflow = 8.5				

JLT LABORATORIES, INC.
GEOTECHNICAL, GEOSYNTHETIC AND MATERIALS TESTING AND RESEARCH

August 17, 2012
12LS2277.03

Golder Associates, Inc.
200 Century Parkway
Suite 200
Mt Laurel, NJ 08054

Attn: Andrew Harpur

RE: COMPATIBILITY TEST RESULTS / MIX SSS-2-2-4
ROC SALEM - NEASE CHEMICAL SITE (933-6154-50005)

Dear Mr. Harpur:

Submitted herein are the results of compatibility testing performed on mix sample SSS-2-2-4 using groundwater identified as GW-TW-06-12. Testing commenced after the sample cured for 30 days under an effective confining stress of 5 psi with a gradient of 25 per ASTM D-7100.

The test ran for eighty-five (85) days and terminated after 2+ pore volumes passed through the sample. After approximately 30 days of testing the permeability stabilized at about 1×10^{-7} cm/sec. There was no evidence in the test to suggest the groundwater adversely effected the mix. There was also no evidence of clogging or the development of biological growth within the sample.

We appreciate the opportunity of being of service to you and look forward to working with you again. Should you have any questions, comments or require additional information, please do not hesitate to call. Thank you.

Sincerely,

JLT LABORATORIES, INC.

John Boschuk, Jr., P.E., C.F.E.
President

cc: Rainer F. Domalski - Invoice Only

Enclosures
JB/mlb
wp10\letter\12214
Inv# 4918

938 South Central Avenue • Canonsburg, Pennsylvania 15317 Tel: (724) 746-4441 Fax: (724) 745-4261

SUMMARY OF FLEX WALL COMPATIBILITY TEST RESULTS

ASTM D-7100 and EPA 9100 Compatibility Testing

JLT

Client	: GOLDER		Date	: 08/17/2012	
Project Location	: Salem		Job No.	: 11LS2277.03	
Description	: Mix SSS-2-2-4		Tested By	: RL / MLB	
Fabrication Date	: 04/24/2012		Checked By	: JBJr	
Start Date	: 05/24/2012		Panel No	: 7	
Age (Days)	: 30		Spec. Gravity	: 2.72	Assumed

Physical Property Data

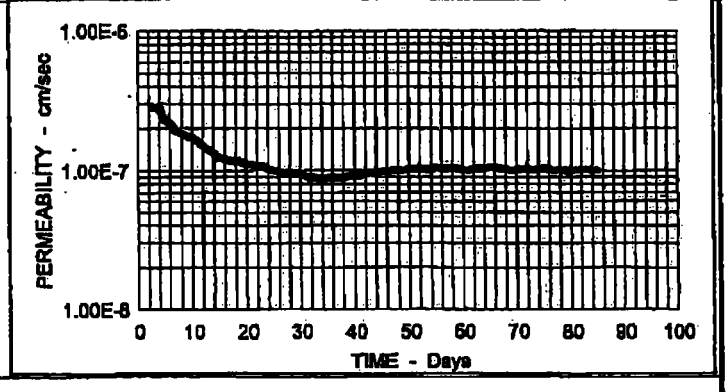
Initial Height (in)	:	3.98	Cut Height (in)	:	3.97
Initial Diameter (in)	:	2.00	Cut Diameter (in)	:	1.98
Initial Wet Weight (g)	:	331.70	Cut Wet Weight (g)	:	360.70
Wet Density (pcf)	:	100.97	Wet Density (pcf)	:	112.09
Moisture Content %	:	31.11	Moisture Content %	:	42.57
Dry Density (pcf)	:	77.01	Dry Density (pcf)	:	78.62
Initial Void Ratio	:	1.2039	Final Void Ratio	:	1.1589
Saturation , %	:	70.3	Saturation , %	:	99.9

Test Parameters

Fluid	:	GW-TW-06-12	Effective		
Cell Pressure (psi)	:	65.00	Confining Pressure (psi)	:	5
Head Water (psi)	:	61.80	Gradient	:	25.03
Tail Water (psi)	:	58.20			

Permeability Input Data
For Last Data Point

Flow, Q	(cc)	:	4.40
Length, L	(in)	:	3.97
Area, A	(sqin)	:	3.09
Head, h	(psi)	:	3.60
Time, t	(min)	:	1442.00
Temp, T	(Deg C)	:	20.4



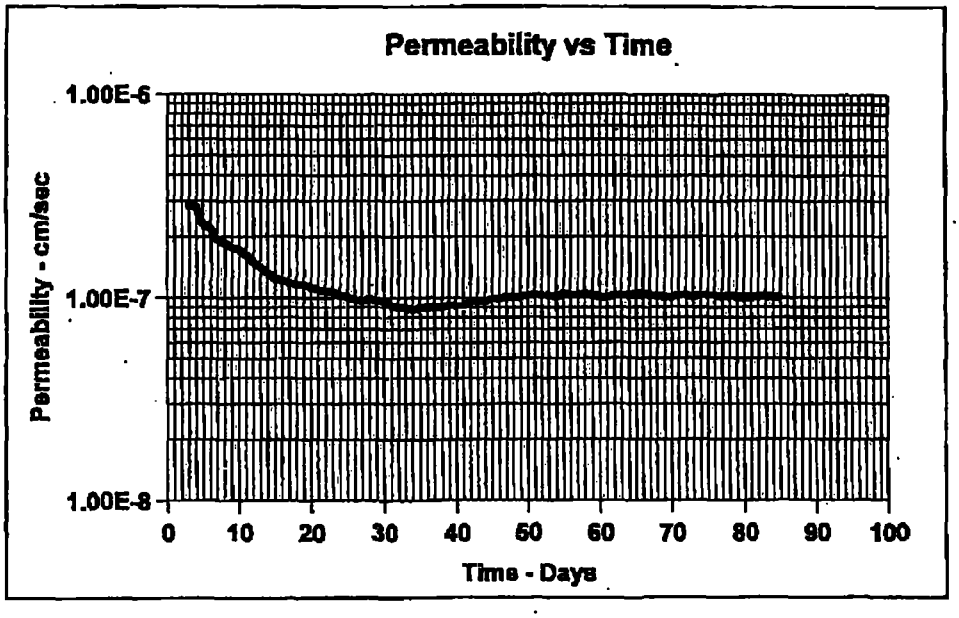
Computed Permeability

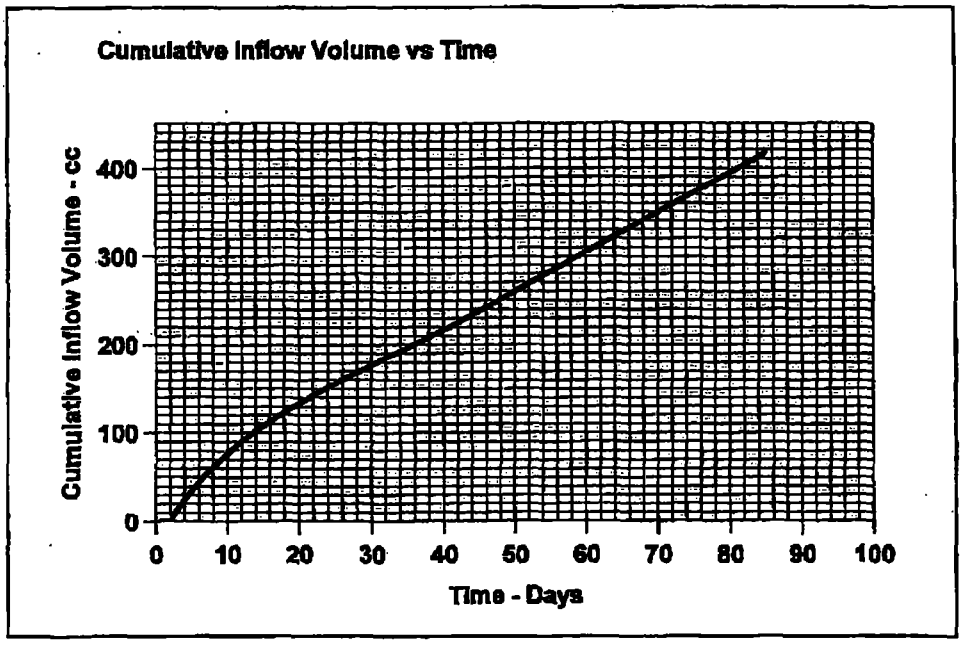
PERMEABILITY, K = 1.01E-007 (cm/sec) at 20 Degrees C
Day 85 **Total Inflow to Date : 415.6 cc**

Description : Mix SSS-2-2-4
Start Date : 05/24/2012

Permeant : GW-TW-06-12

Date : 08/17/2012
Computed Initial Pore Volume : 131.25 cc
Estimated Inflow Pore Volumes : 3.17 cc





JLT Laboratories, Inc.

Client : GOLDER
Project Location : Salem
Description : Mix SSS-2-2-4
Start Date : 05/24/2012

Date : 08/17/2012
Job No. : 11LS2277.03
Tested By : RL / MLB
Checked By : JBJr

Initial Pore Volume : 131.25 cc
Final Pore Volume : 129 cc

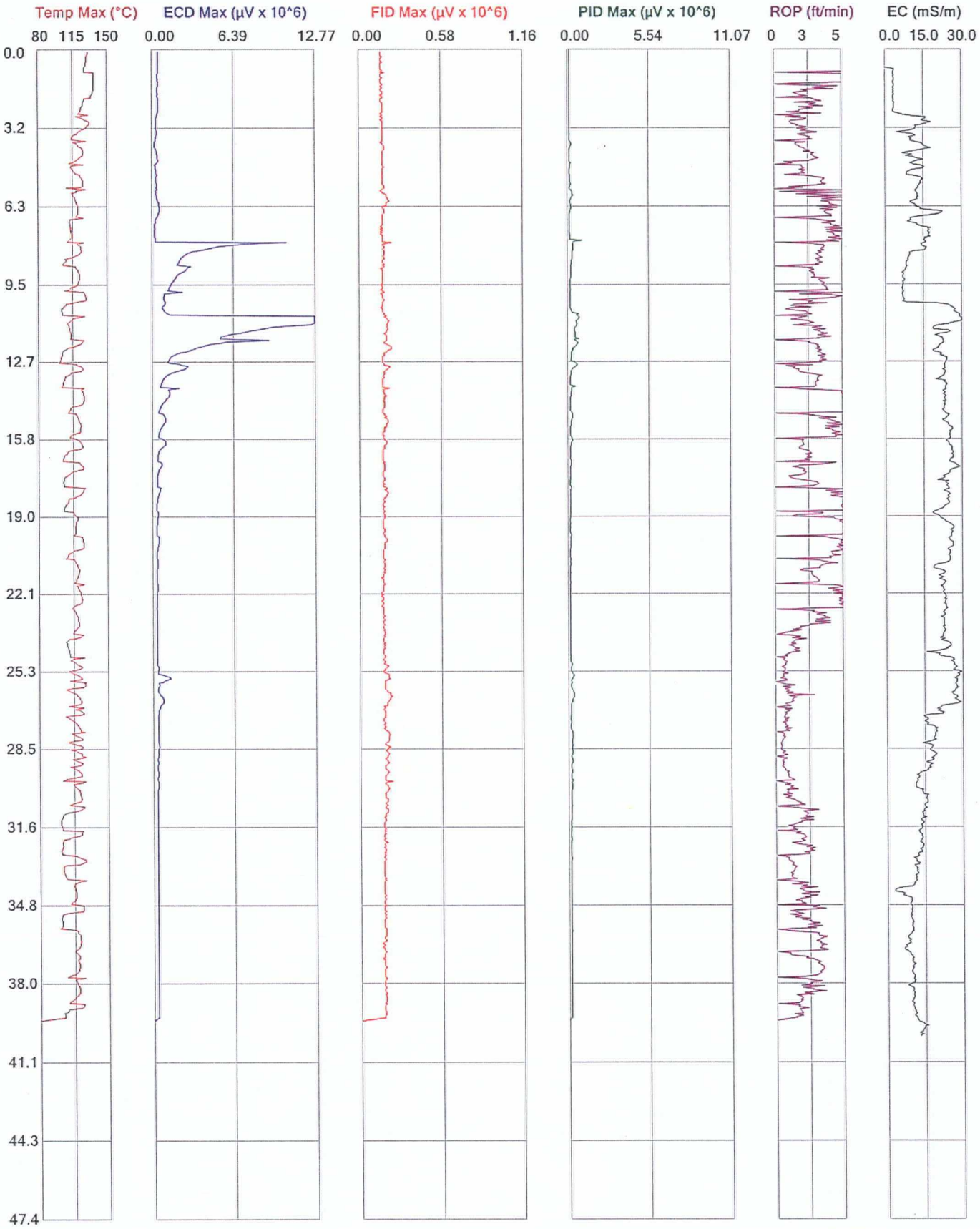
Elapsed Time Days	Permeability cm/sec	Inflow cc	Time minutes	Date	Total Cumulative Inflow, cc	Inflow Pore Volume	COMMENTS
1				05/24/2012	0.0	0	Start with Site Groundwater
2				05/25/2012	0.0	0.00	Consolidate two Days
3	2.84E-007	12.4	1442	05/26/2012	12.4	0.09	GW-TW-06-12
4	2.83E-007	12.3	1438	05/27/2012	24.7	0.19	
5	2.29E-007	10.0	1442	05/28/2012	34.7	0.26	
6	2.21E-007	9.6	1438	05/29/2012	44.3	0.34	
7	1.93E-007	8.4	1440	05/30/2012	52.7	0.40	Inflow and Outflow are Equal
8	1.86E-007	8.1	1442	05/31/2012	60.8	0.46	
9	1.77E-007	7.7	1439	06/01/2012	68.5	0.52	
10	1.72E-007	7.5	1440	06/02/2012	76.0	0.58	
11	1.63E-007	7.1	1439	06/03/2012	83.1	0.63	
12	1.51E-007	6.6	1441	06/04/2012	89.7	0.68	
13	1.42E-007	6.2	1442	06/05/2012	95.9	0.73	
14	1.33E-007	5.8	1439	06/06/2012	101.7	0.77	
15	1.24E-007	5.4	1437	06/07/2012	107.1	0.82	
16	1.22E-007	5.3	1439	06/08/2012	112.4	0.86	
17	1.19E-007	5.2	1444	06/09/2012	117.6	0.90	
18	1.17E-007	5.1	1438	06/10/2012	122.7	0.93	
19	1.17E-007	5.1	1439	06/11/2012	127.8	0.97	
20	1.13E-007	4.9	1440	06/12/2012	132.7	1.01	
21	1.10E-007	4.8	1441	06/13/2012	137.5	1.05	
22	1.08E-007	4.7	1440	06/14/2012	142.2	1.08	
23	1.08E-007	4.7	1441	06/15/2012	146.9	1.12	
24	1.03E-007	4.5	1442	06/16/2012	151.4	1.15	
25	1.01E-007	4.4	1438	06/17/2012	155.8	1.19	
26	9.88E-008	4.3	1439	06/18/2012	160.1	1.22	
27	9.63E-008	4.2	1443	06/19/2012	164.3	1.25	
28	9.88E-008	4.3	1439	06/20/2012	168.6	1.28	
29	9.63E-008	4.2	1442	06/21/2012	172.8	1.32	
30	9.67E-008	4.2	1437	06/22/2012	177.0	1.35	
31	9.19E-008	4.0	1439	06/23/2012	181.0	1.38	
32	8.94E-008	3.9	1443	06/24/2012	184.9	1.41	
33	8.97E-008	3.9	1438	06/25/2012	188.8	1.44	
34	8.73E-008	3.8	1440	06/26/2012	192.6	1.47	
35	8.94E-008	3.9	1442	06/27/2012	196.5	1.50	
36	8.96E-008	3.9	1440	06/28/2012	200.4	1.53	
37	8.96E-008	3.9	1439	06/29/2012	204.3	1.56	
38	8.96E-008	3.9	1439	06/30/2012	208.2	1.59	
39	9.17E-008	4.0	1442	07/01/2012	212.2	1.62	
40	9.18E-008	4.0	1441	07/02/2012	216.2	1.65	
41	9.19E-008	4.0	1440	07/03/2012	220.2	1.68	
42	9.63E-008	4.2	1442	07/04/2012	224.4	1.71	
43	9.64E-008	4.2	1441	07/05/2012	228.6	1.74	
44	9.66E-008	4.2	1438	07/06/2012	232.8	1.77	
45	9.88E-008	4.3	1439	07/07/2012	237.1	1.81	
46	9.89E-008	4.3	1438	07/08/2012	241.4	1.84	
47	1.01E-007	4.4	1440	07/09/2012	245.8	1.87	
48	1.01E-007	4.4	1441	07/10/2012	250.2	1.91	
49	1.01E-007	4.4	1440	07/11/2012	254.6	1.94	
50	1.03E-007	4.5	1442	07/12/2012	259.1	1.97	
51	1.03E-007	4.5	1441	07/13/2012	263.6	2.01	

52	1.03E-007	4.5	1443	07/14/2012	268.1	2.04	Page 2
53	1.03E-007	4.5	1441	07/15/2012	272.6	2.08	
54	1.01E-007	4.4	1439	07/16/2012	277.0	2.11	
55	1.05E-007	4.6	1442	07/17/2012	281.6	2.15	
56	1.03E-007	4.5	1443	07/18/2012	286.1	2.18	
57	1.04E-007	4.5	1437	07/19/2012	290.6	2.21	
58	1.05E-007	4.6	1449	07/20/2012	295.2	2.25	
59	1.03E-007	4.5	1440	07/21/2012	299.7	2.28	
60	1.01E-007	4.4	1439	07/22/2012	304.1	2.32	
61	1.01E-007	4.4	1442	07/23/2012	308.5	2.35	
62	1.03E-007	4.5	1440	07/24/2012	313.0	2.38	
63	1.03E-007	4.5	1438	07/25/2012	317.5	2.42	
64	1.03E-007	4.5	1441	07/26/2012	322.0	2.45	
65	1.05E-007	4.6	1442	07/27/2012	326.6	2.49	
66	1.06E-007	4.6	1440	07/28/2012	331.2	2.52	
67	1.03E-007	4.5	1441	07/29/2012	335.7	2.56	
68	1.03E-007	4.5	1445	07/30/2012	340.2	2.59	
69	1.01E-007	4.4	1442	07/31/2012	344.6	2.63	
70	1.01E-007	4.4	1441	08/01/2012	349.0	2.66	
71	1.03E-007	4.5	1442	08/02/2012	353.5	2.69	
72	1.03E-007	4.5	1438	08/03/2012	358.0	2.73	
73	1.01E-007	4.4	1439	08/04/2012	362.4	2.76	
74	1.03E-007	4.5	1441	08/05/2012	366.9	2.80	
75	1.03E-007	4.5	1438	08/06/2012	371.4	2.83	
76	1.03E-007	4.5	1439	08/07/2012	375.9	2.86	
77	1.01E-007	4.4	1442	08/08/2012	380.3	2.90	
78	1.03E-007	4.5	1440	08/09/2012	384.8	2.93	
79	1.01E-007	4.4	1441	08/10/2012	389.2	2.97	
80	1.01E-007	4.4	1442	08/11/2012	393.6	3.00	
81	1.01E-007	4.4	1441	08/12/2012	398.0	3.03	
82	1.01E-007	4.4	1438	08/13/2012	402.4	3.07	
83	1.03E-007	4.4	1419	08/14/2012	406.8	3.10	
84	1.01E-007	4.4	1441	08/15/2012	411.2	3.13	
85	1.01E-007	4.4	1442	08/16/2012	415.6	3.17	Test Terminated

Final pH Values
Inflow pH : 7.16
Outflow pH : 11.18

APPENDIX D

MIP/EC RESULTS



COLUMBIA TECHNOLOGIES

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Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES

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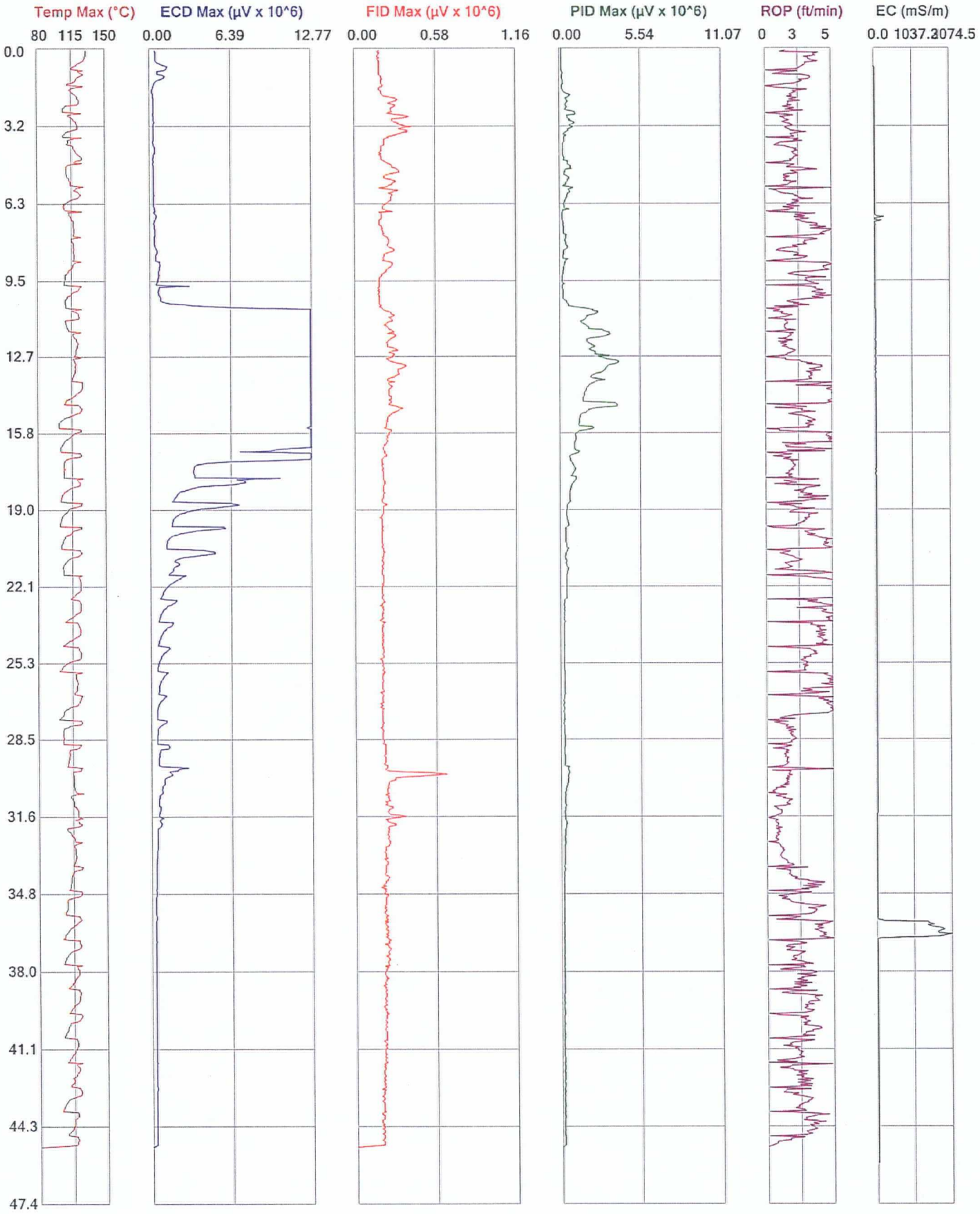
Project ID: Former Nease Chemical Site	Location:



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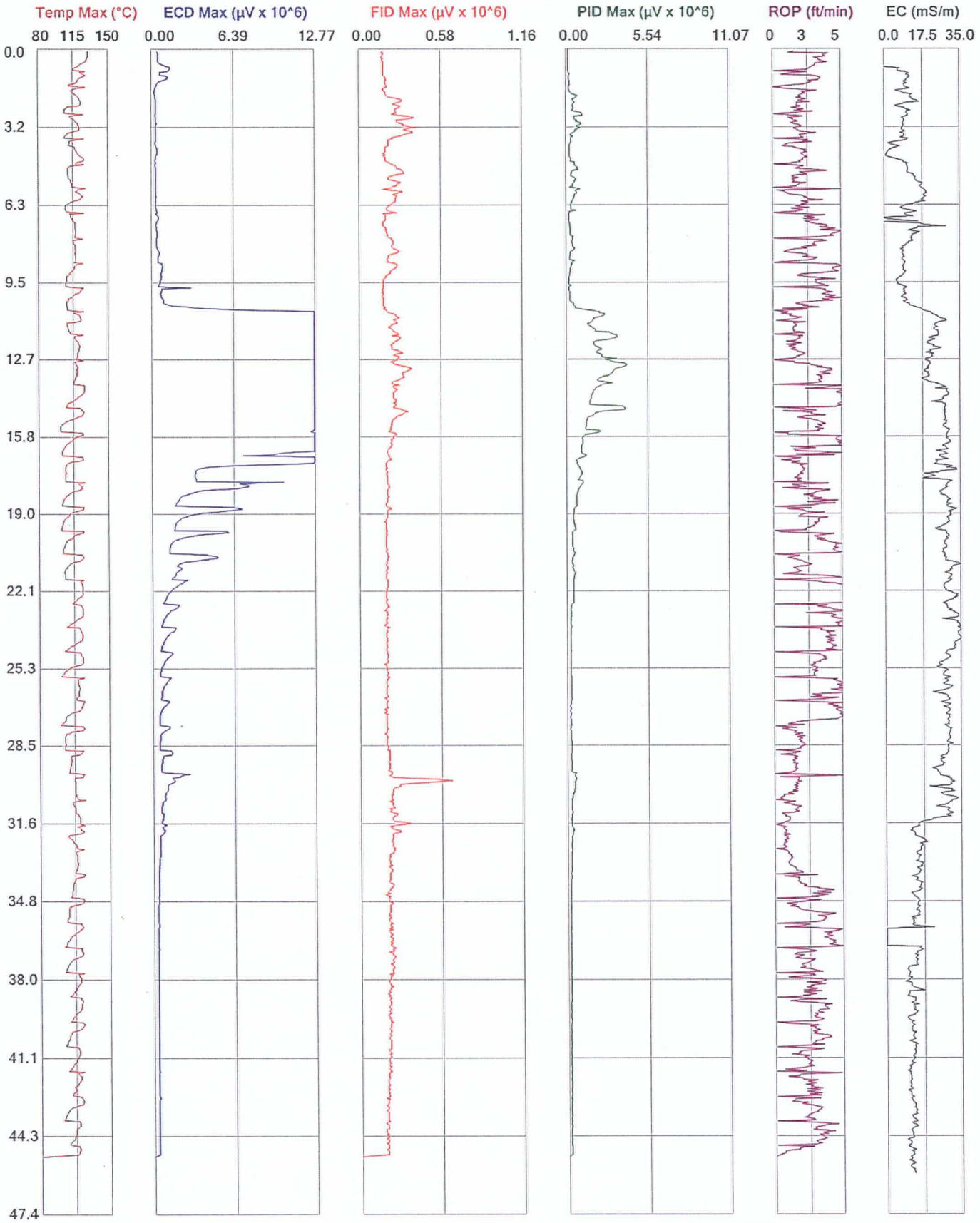

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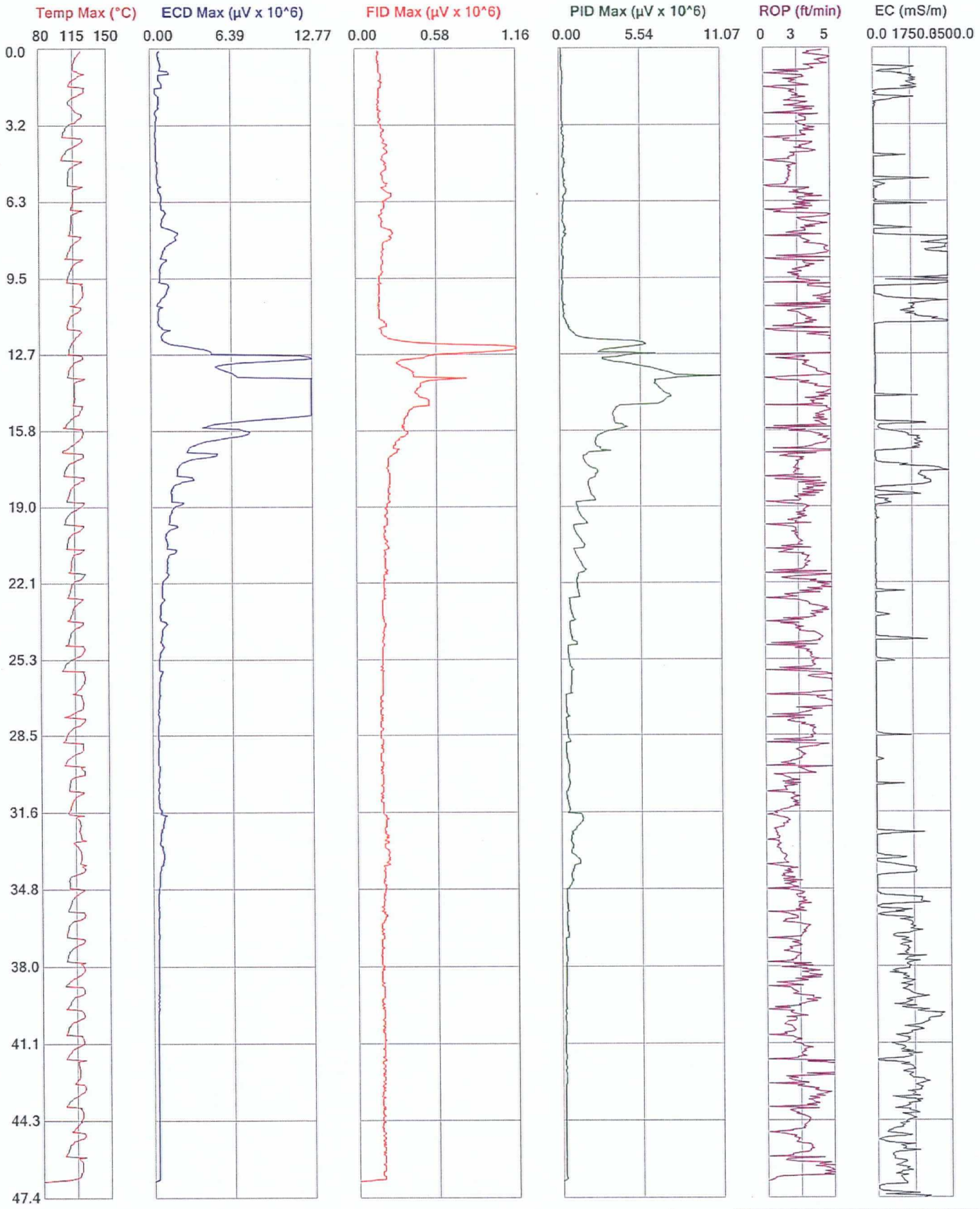

COLUMBIA TECHNOLOGIES

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Project ID: Former Nease Chemical Site	Location:

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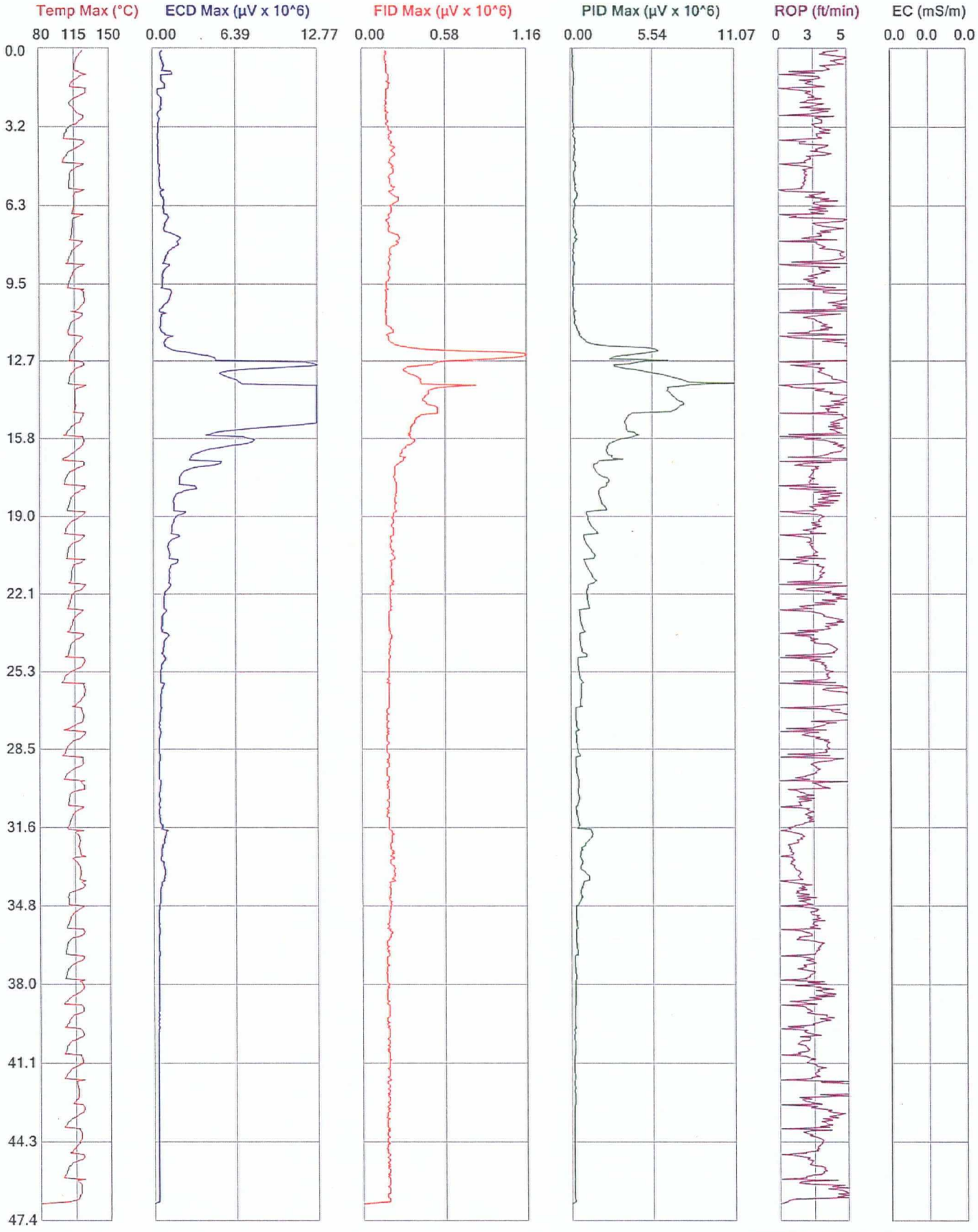

COLUMBIA TECHNOLOGIES

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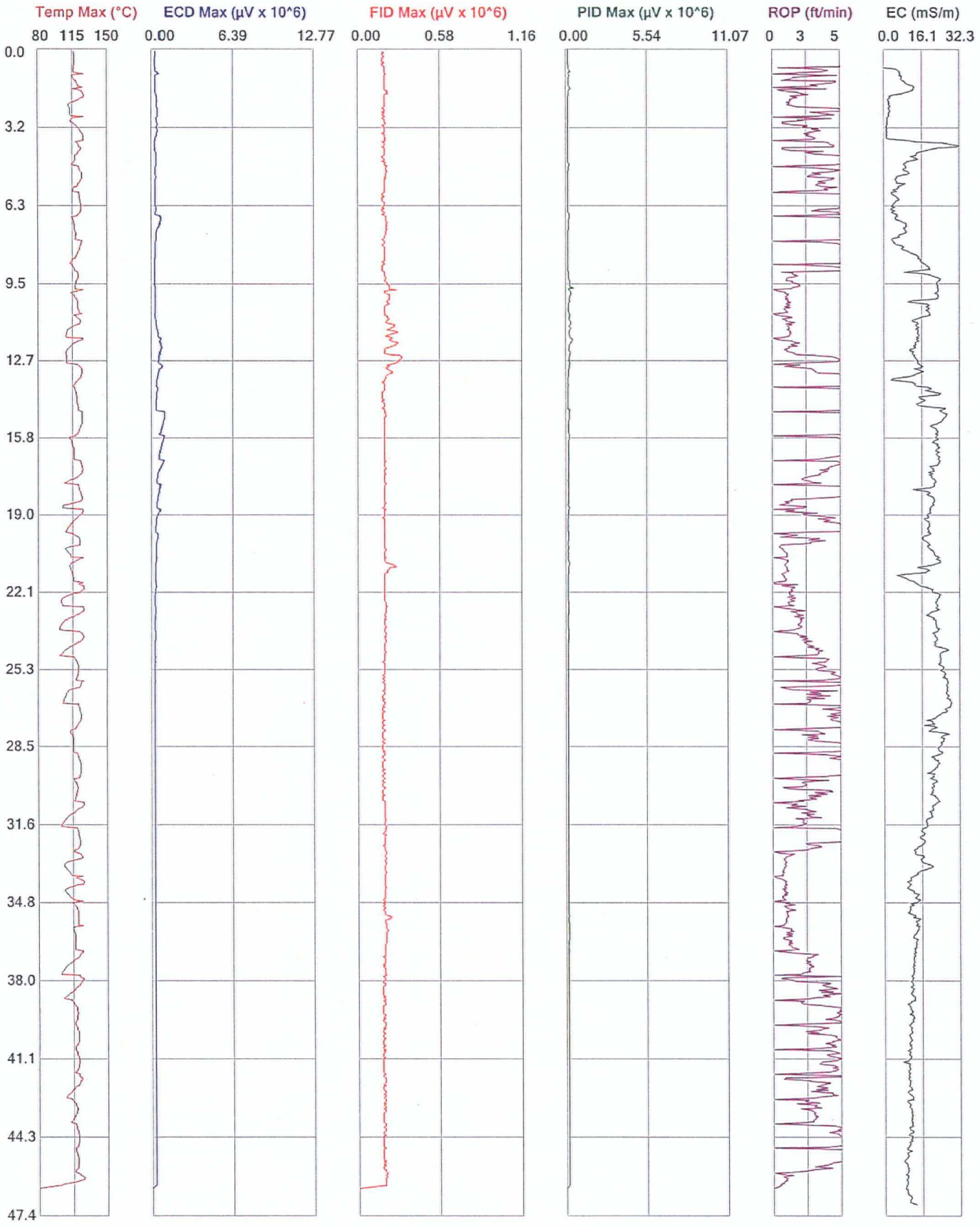

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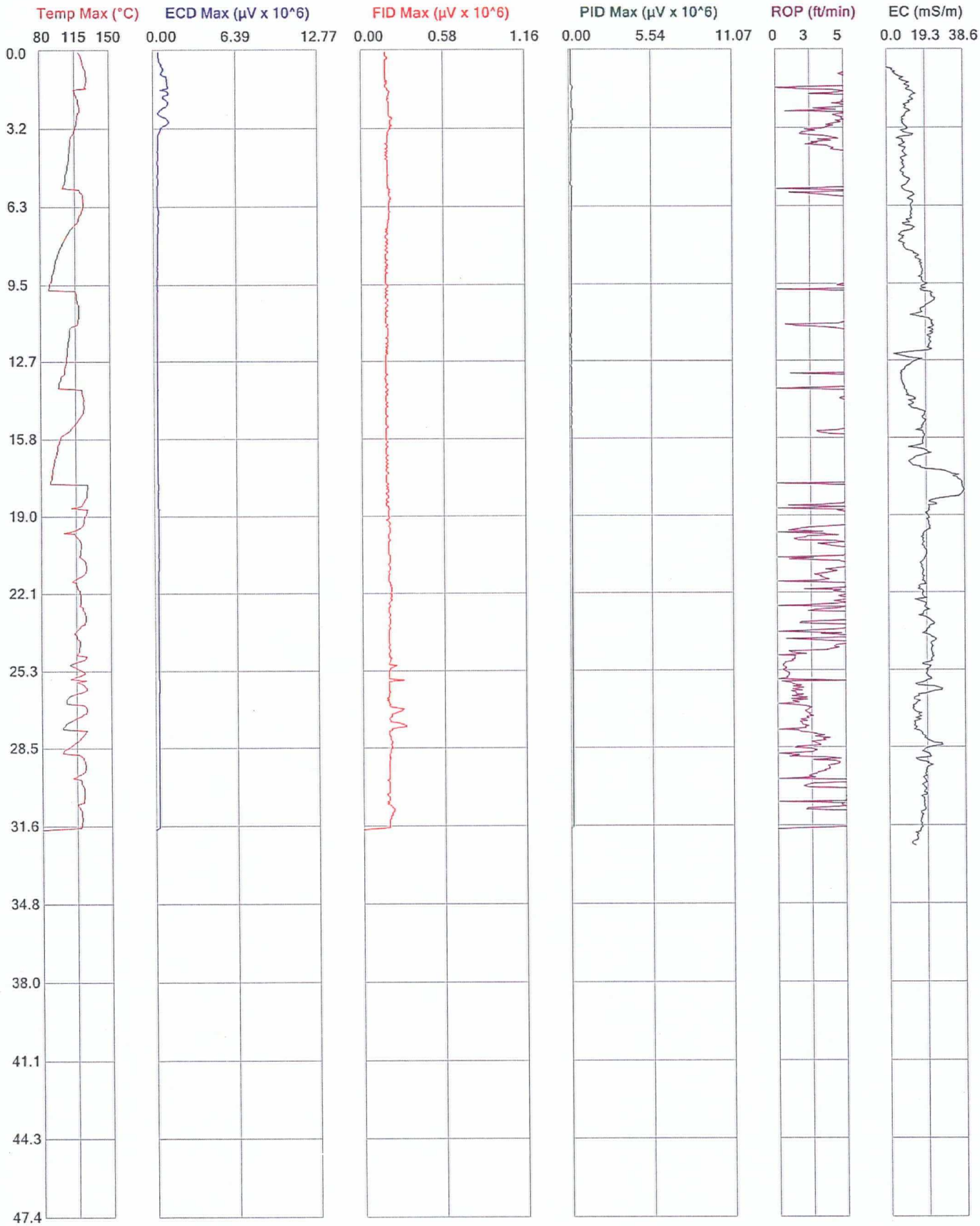
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



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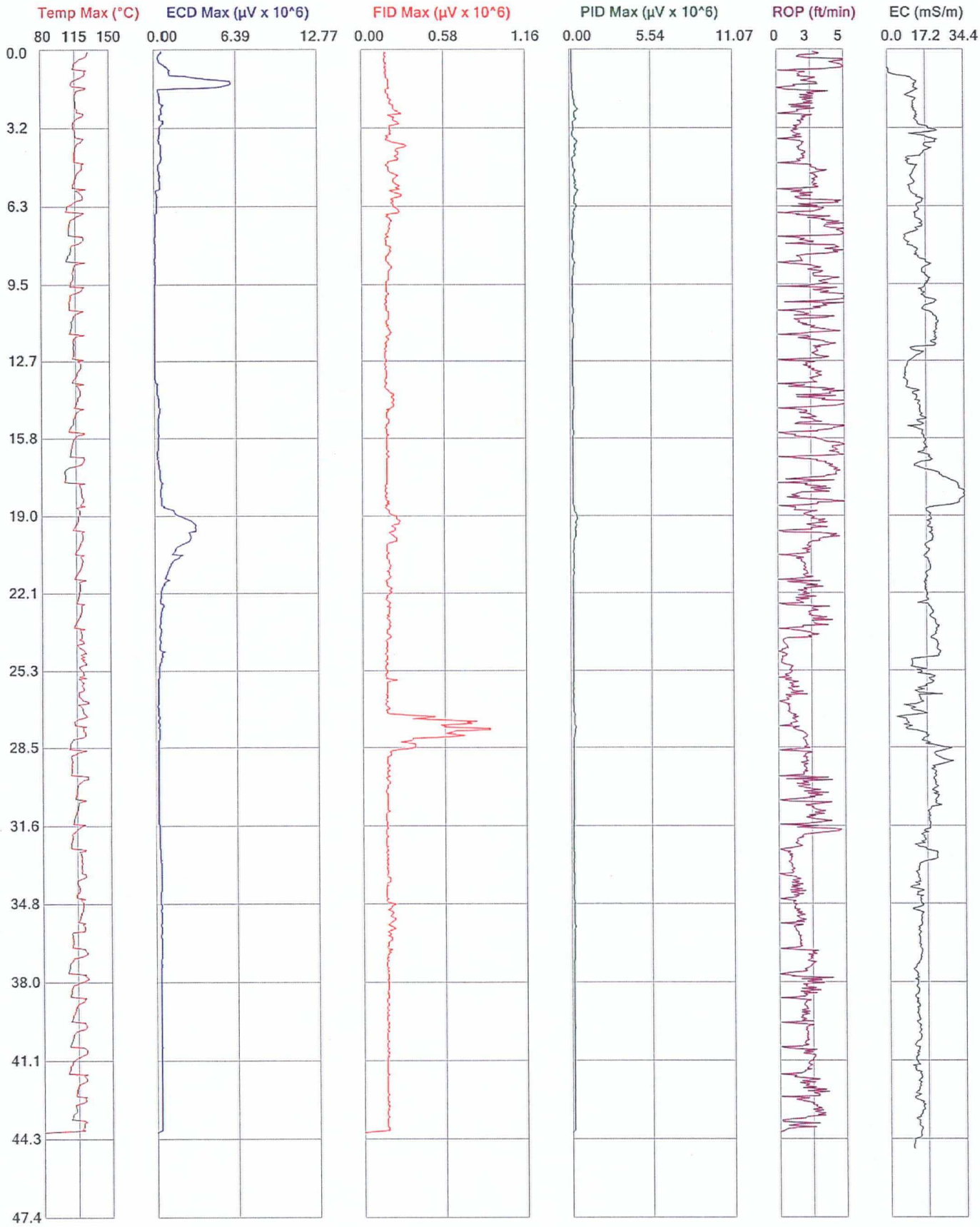
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



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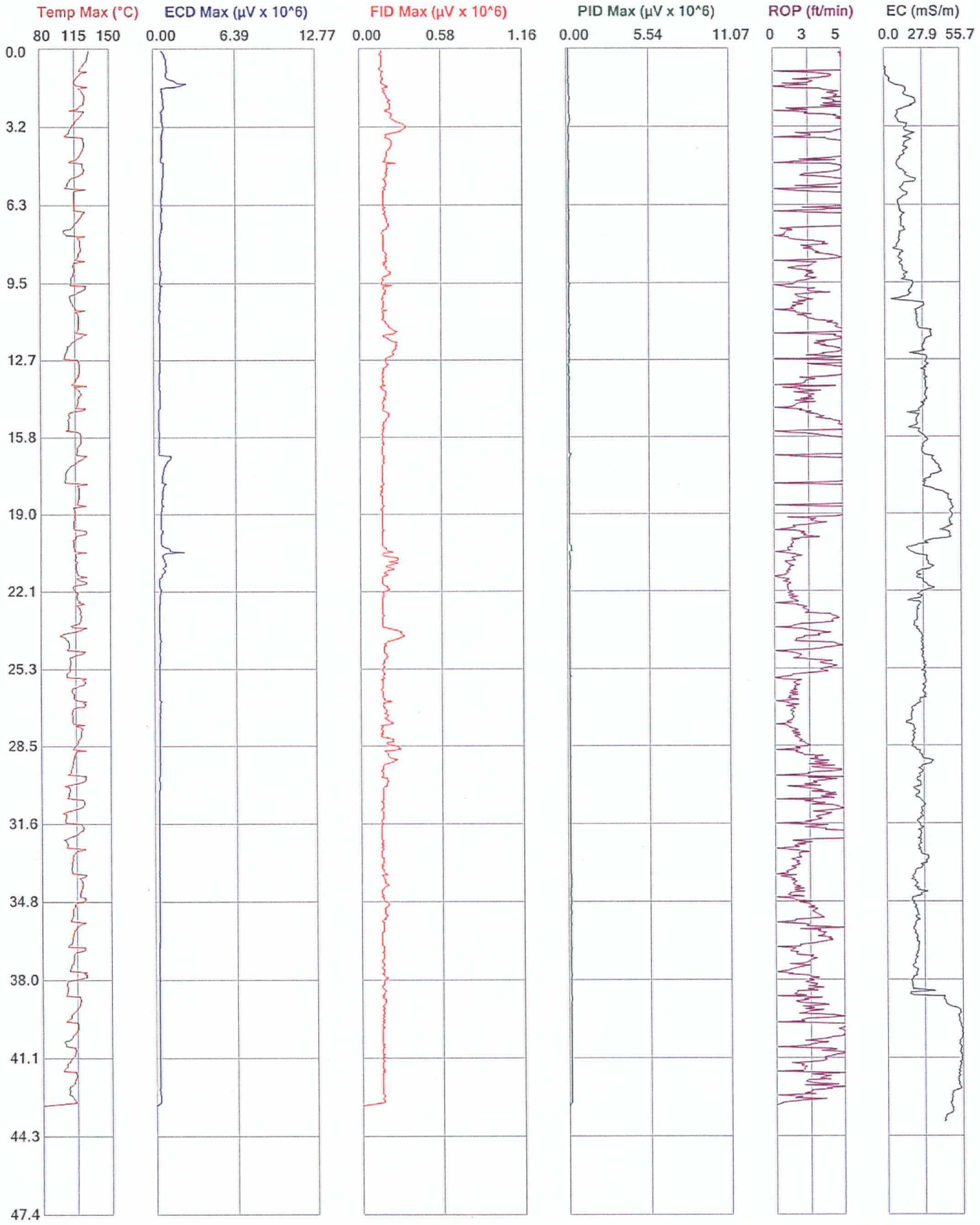
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



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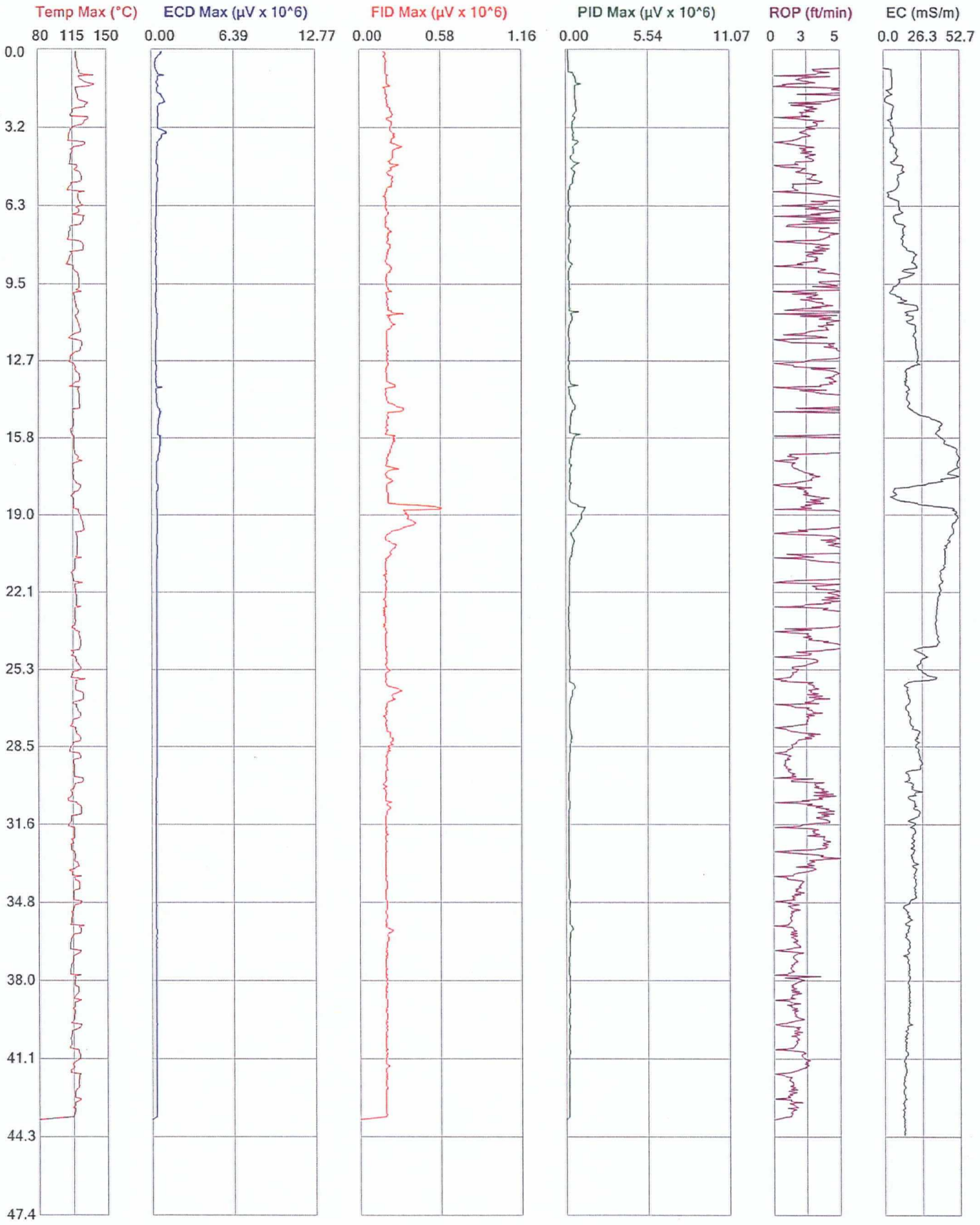

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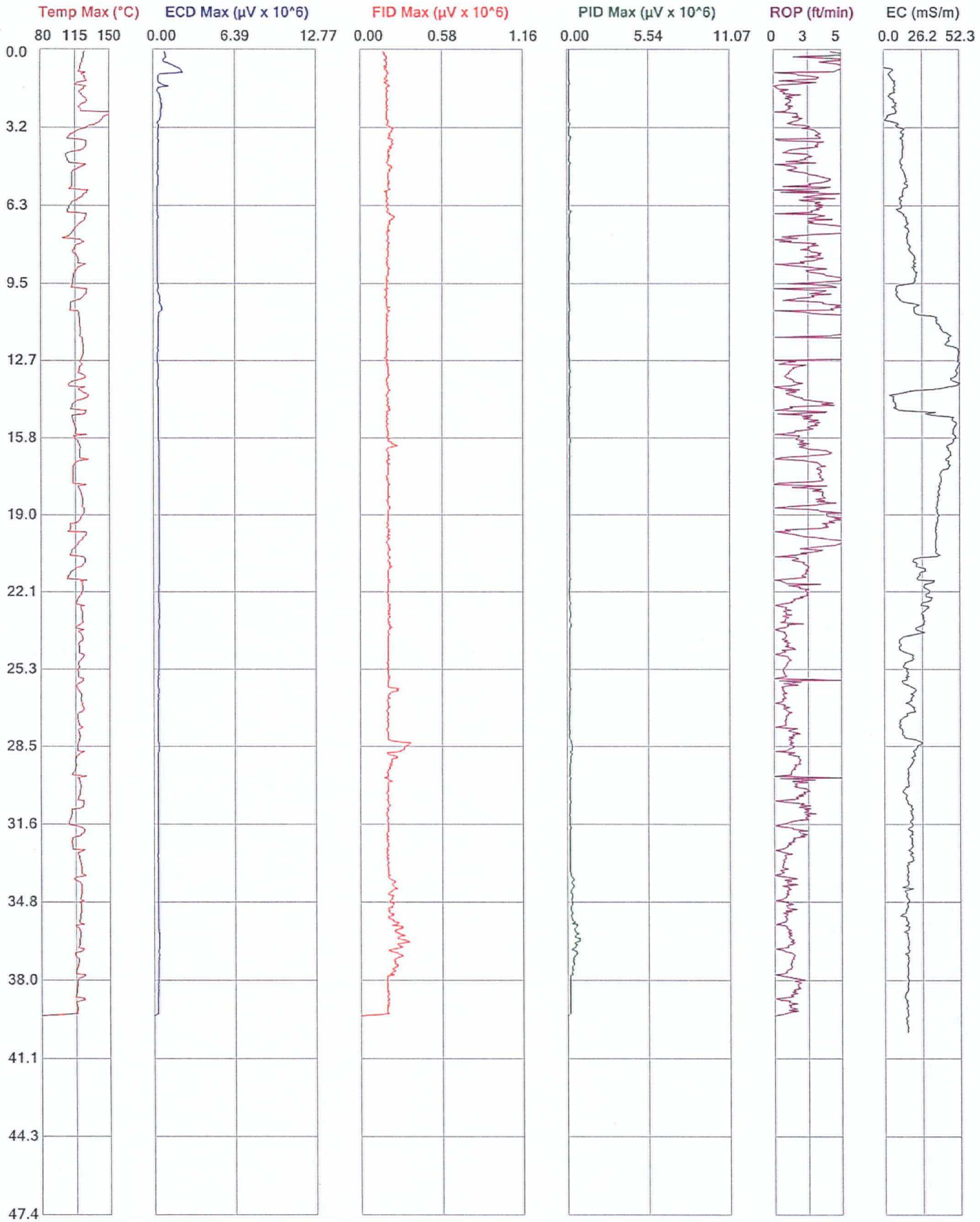

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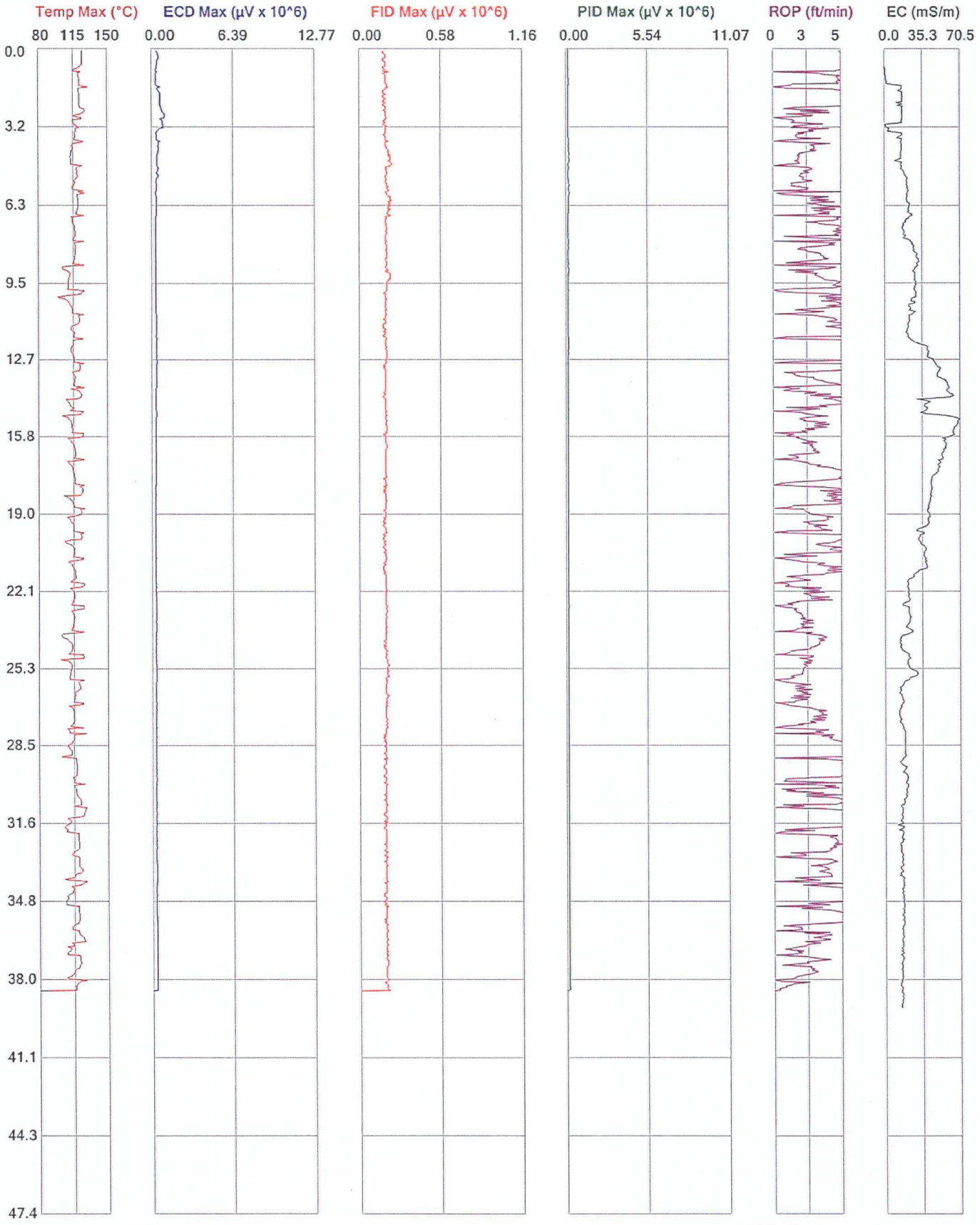

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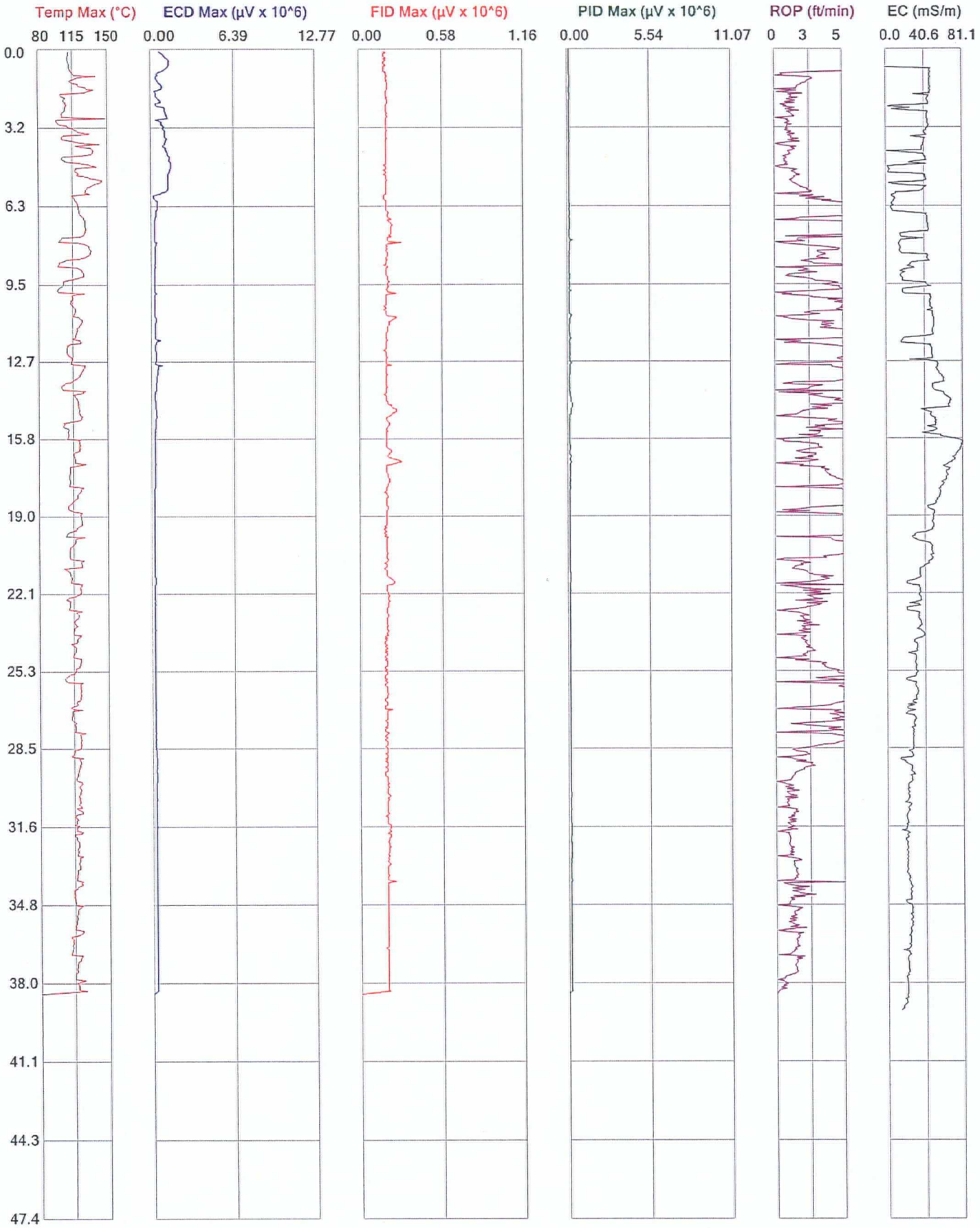
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



COLUMBIA TECHNOLOGIES

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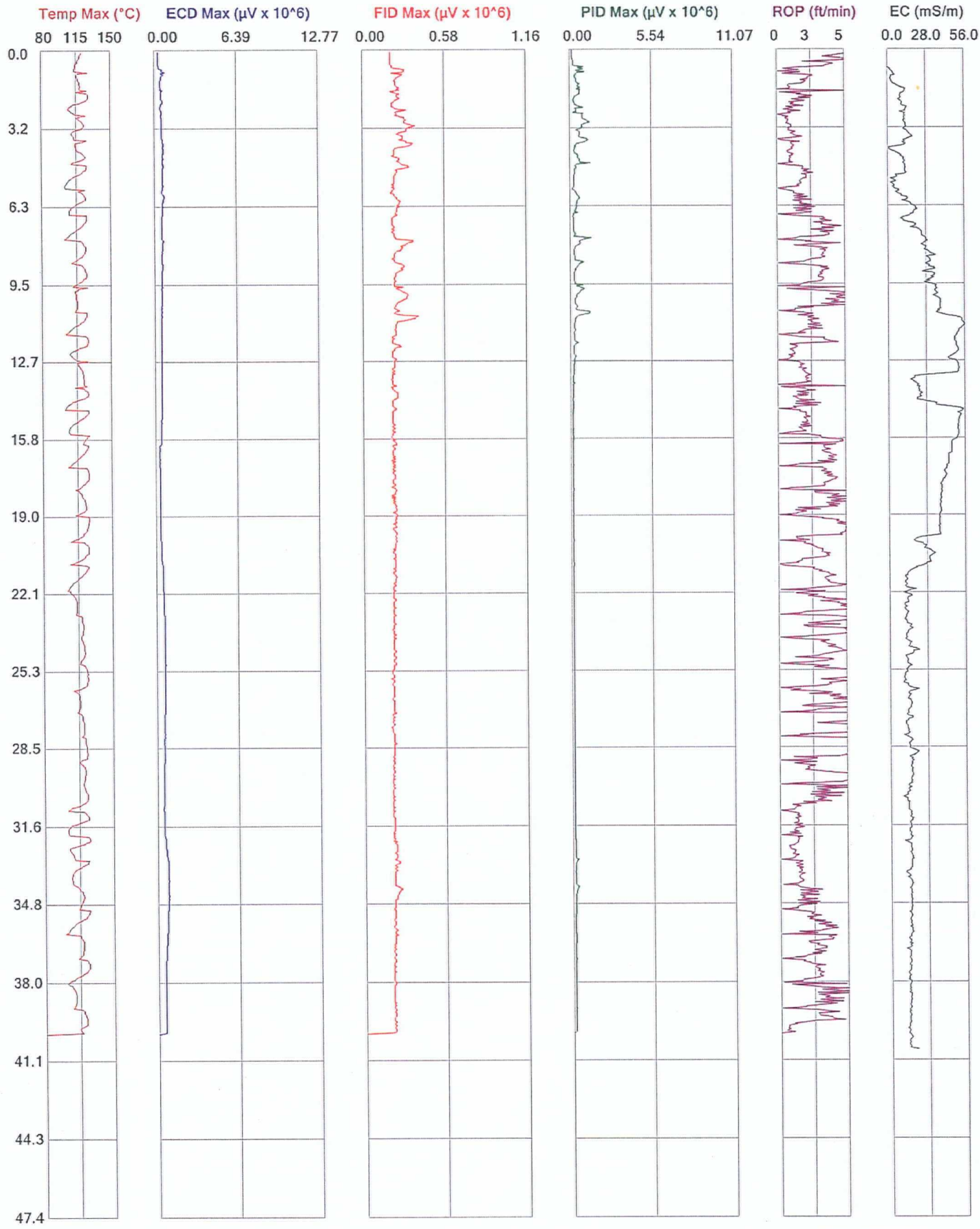

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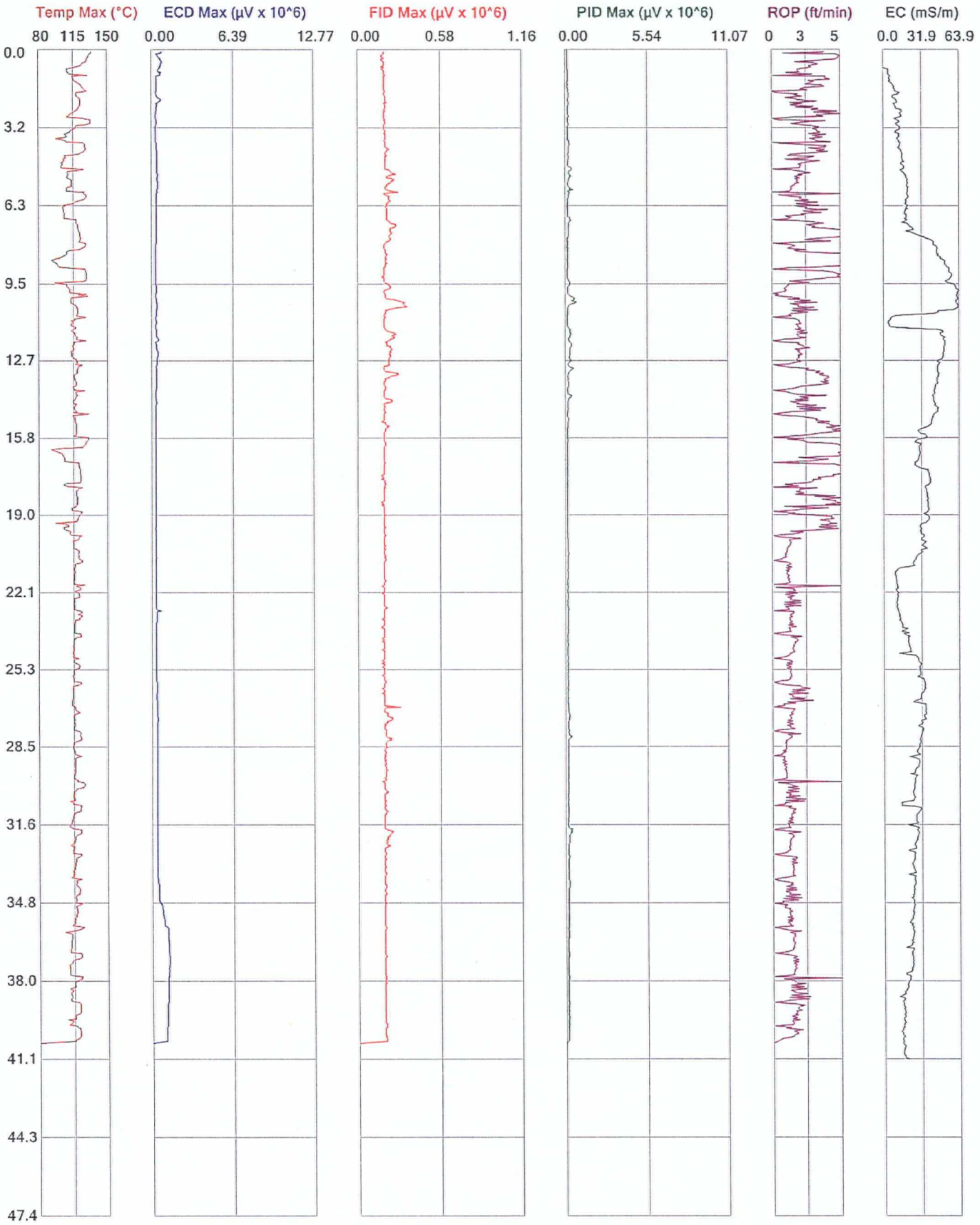
COLUMBIA TECHNOLOGIES



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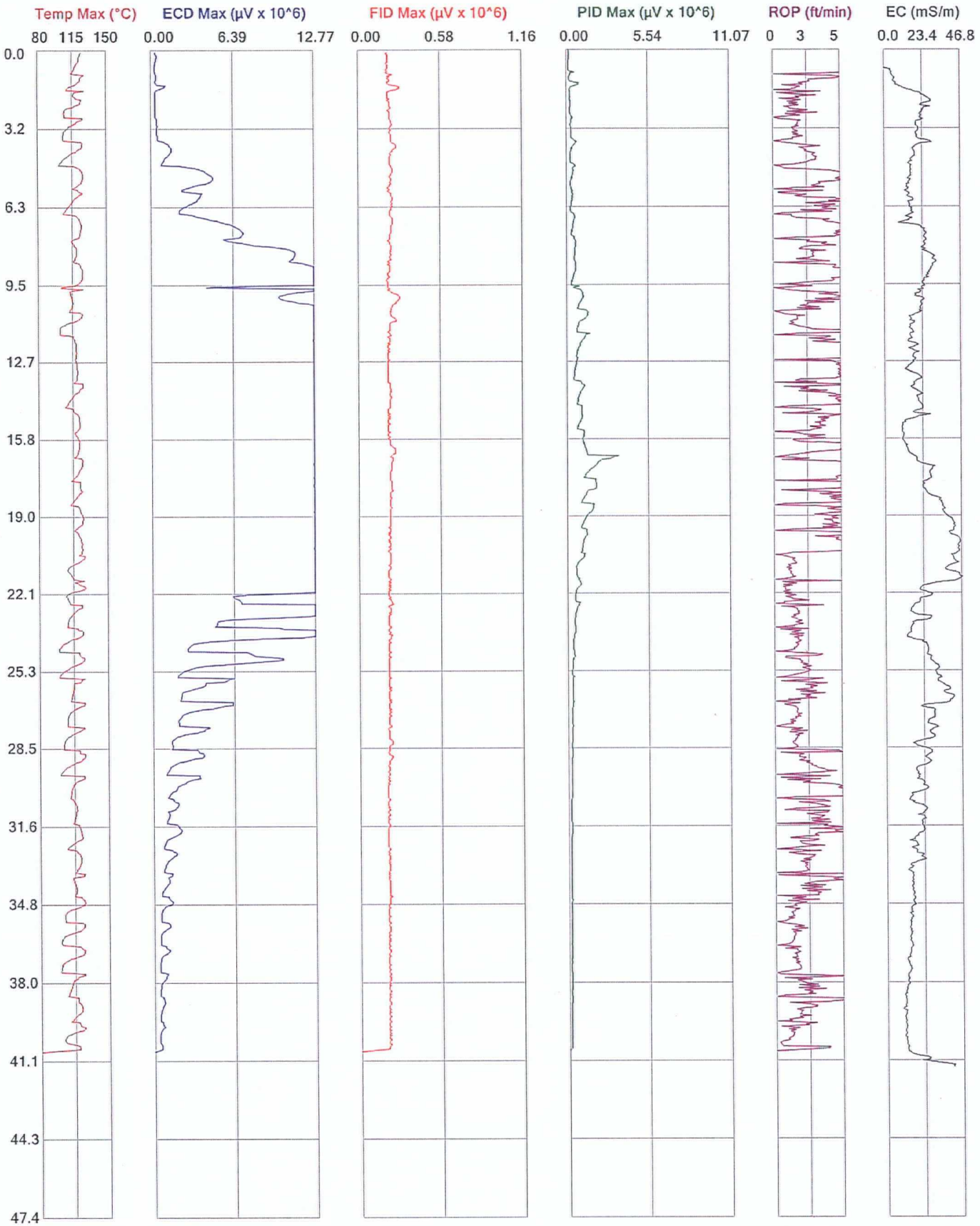
COLUMBIA TECHNOLOGIES



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COLUMBIA TECHNOLOGIES

COLUMBIA TECHNOLOGIES

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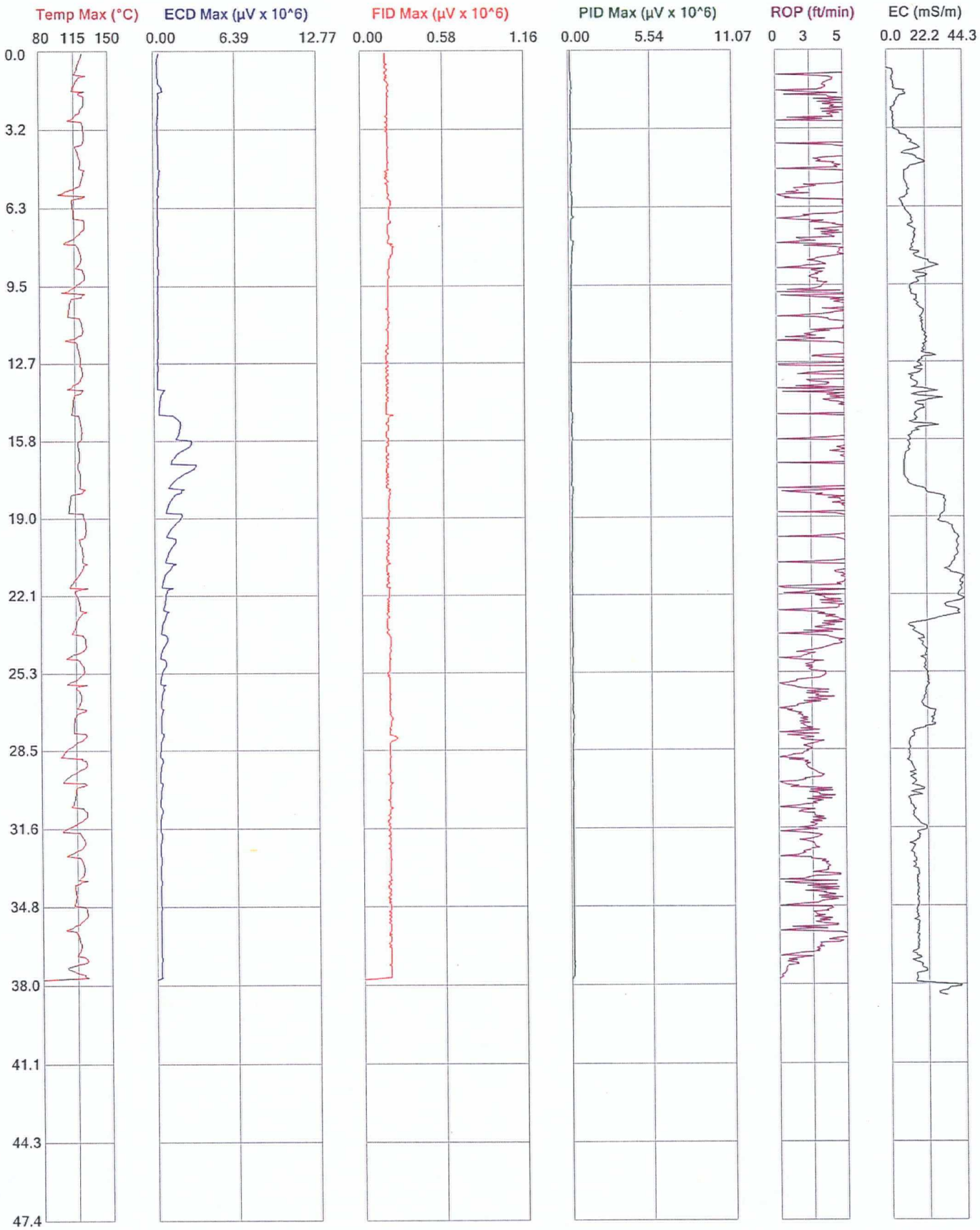

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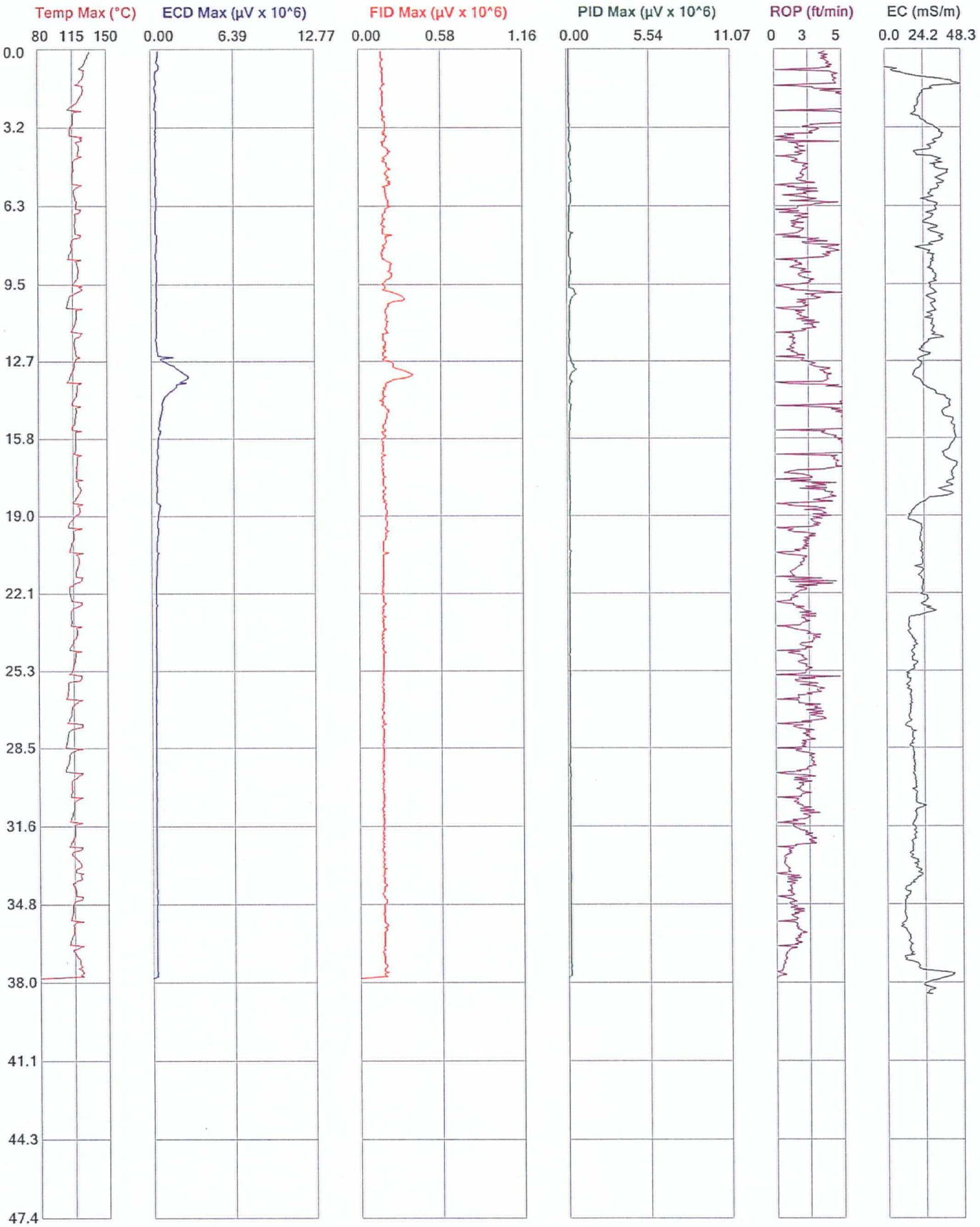
COLUMBIA TECHNOLOGIES



COLUMBIA TECHNOLOGIES

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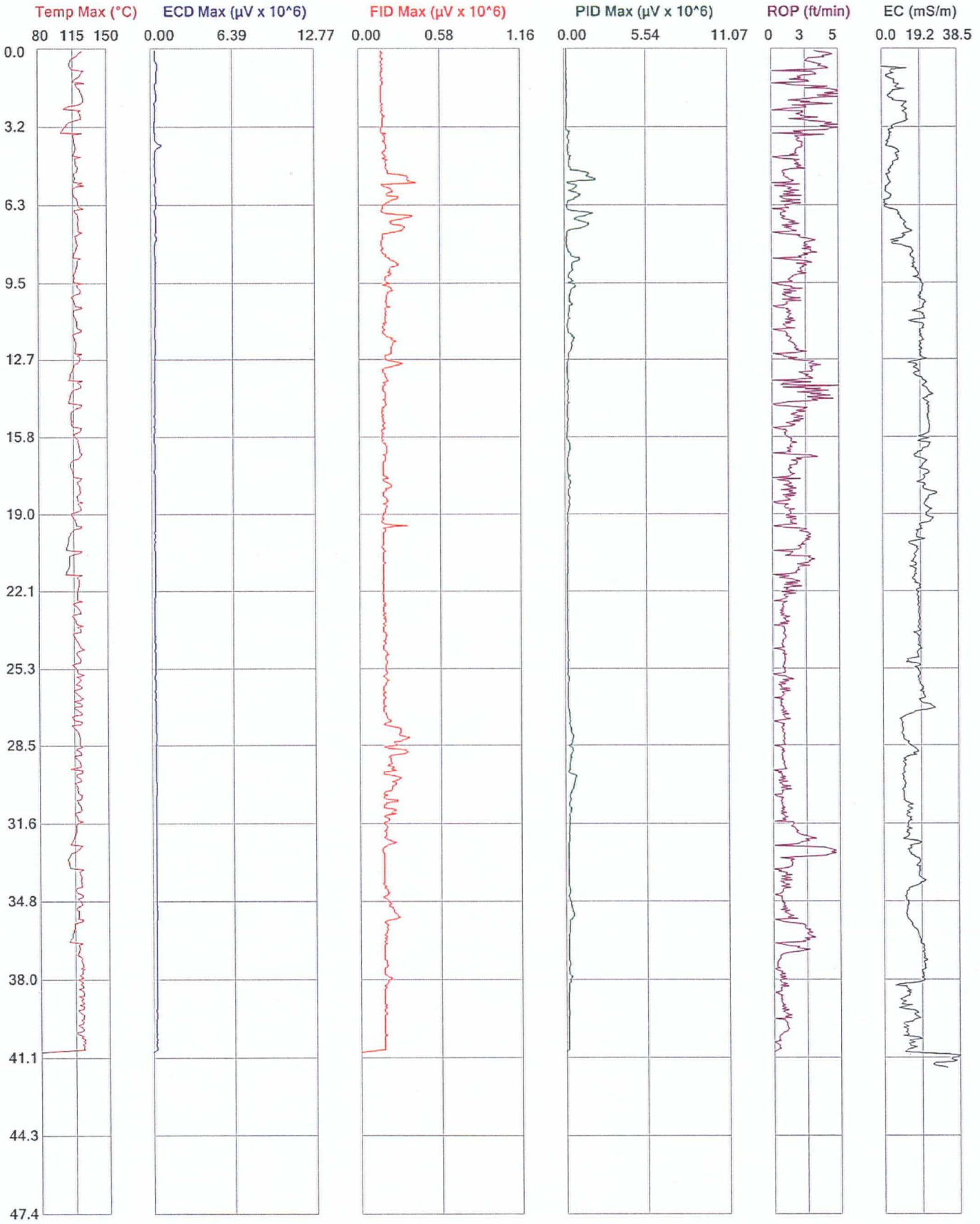

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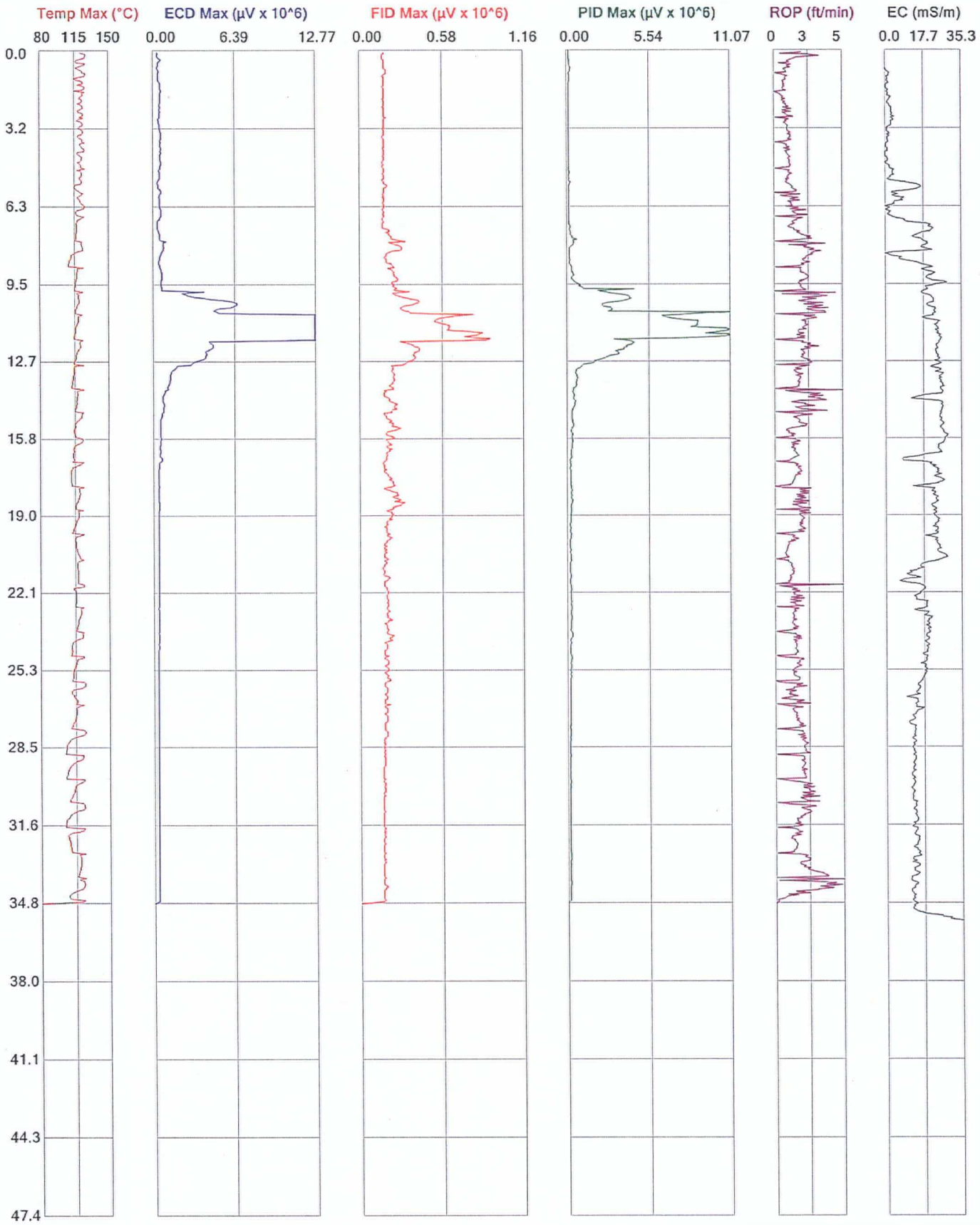
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



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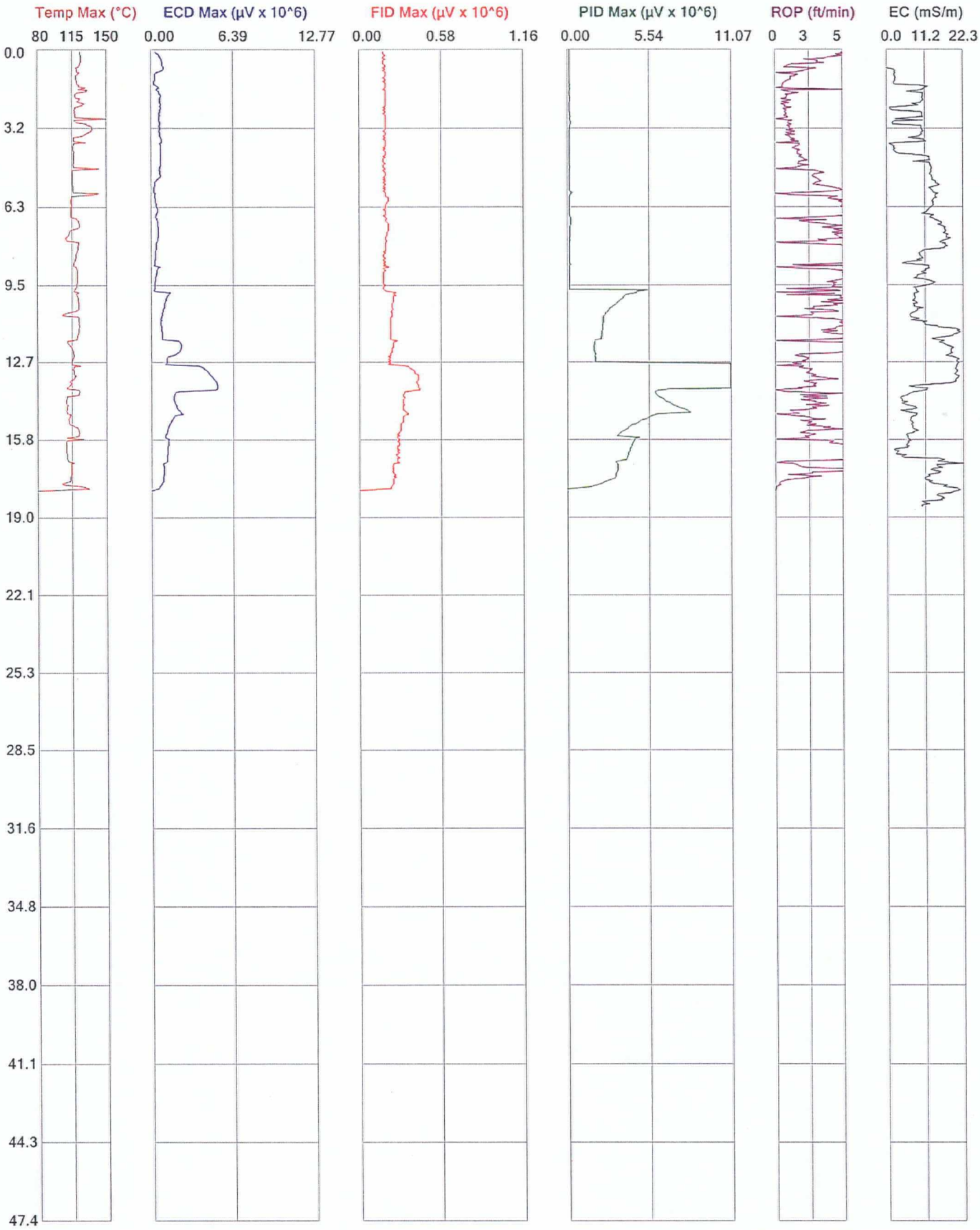
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES



COLUMBIA TECHNOLOGIES

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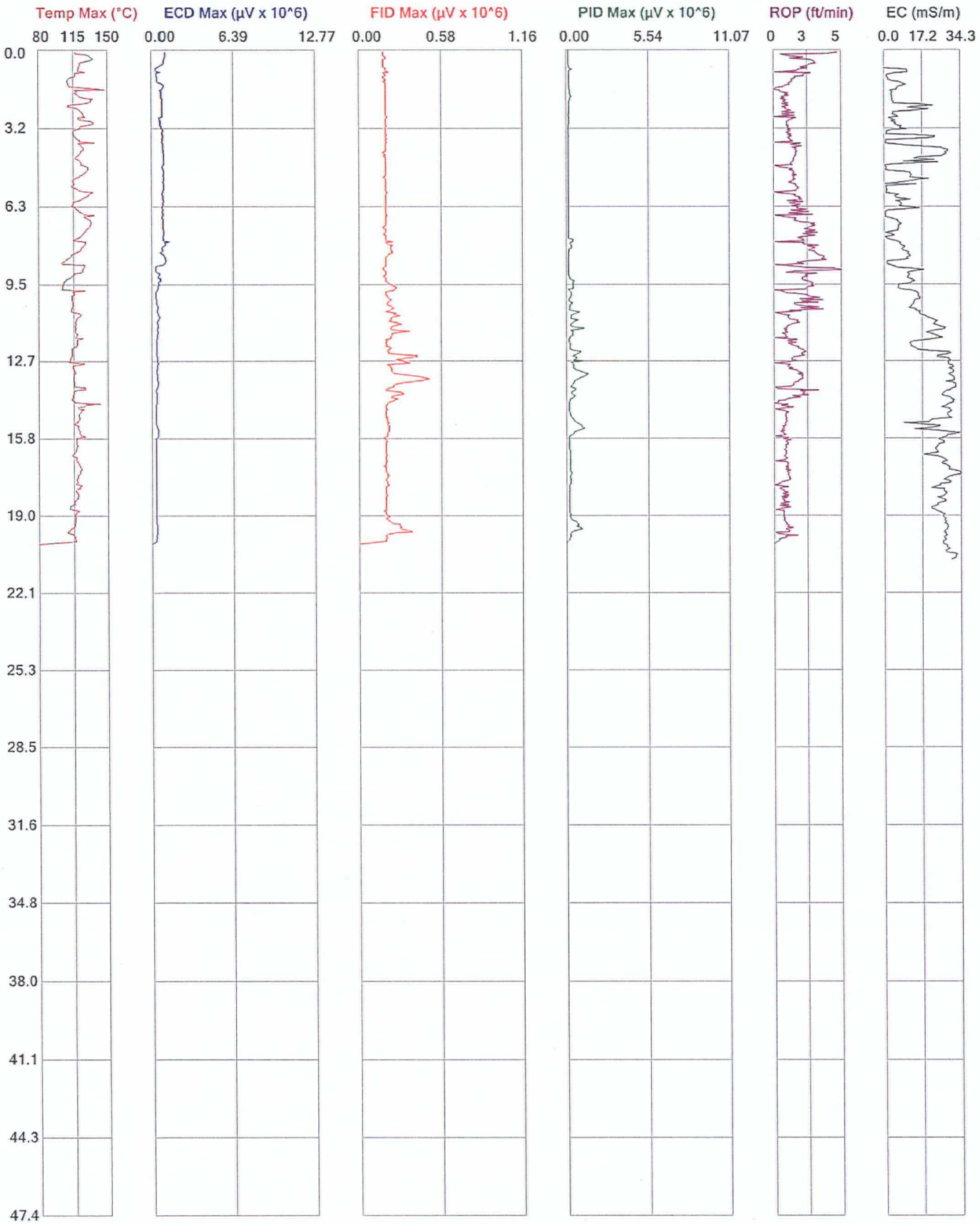

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Client: Golder Associates	Date: 11/17/2011
Project ID: Former Nease Chemical Site	Location:

COLUMBIA TECHNOLOGIES

APPENDIX E

WELL DEVELOPMENT LOGS

WELL DEVELOPMENT FIELD RECORD

JOB NAME	ROC - Salem		JOB NO.	933-6154-005	WELL NO. MW12-52
DEVELOPED BY	Jonathan Harris & Krista Cione		DATE OF INSTALL.	7/26/2012	SHEET _1__ of __1___
STARTED DEVEL.	7/28/2012	10:30	COMPLETED DEVEL.	NA	/
	DATE	TIME		DATE	TIME
W.L. BEFORE DEVEL.	15.00	7/28/2012 10:18	W.L. AFTER DEVEL.	NA /	/
	DEPTH	DATE TIME		DEPTH	DATE TIME
WELL DEPTH: BEFORE DEVEL.	23.1		AFTER DEVEL.	NA	WELL DIA. (In)_____
STANDING WATER COLUMN (FT.)	8.1		STANDING WELL VOLUME	1.3	gal.
SCREEN LENGTH	2'		DRILLING WATER LOSS		gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/28/2012	10:30	1.3	0.805	16.89	7.2	>1000	DTW - 20.32, moderate to heavy solids
	10:41	2.6	0.704	17.09	7.13	>1000	DTW - 22.63, heavy solids, bailed dry
7/29/2012	9:45	3.6					DTW - 23.09, bailed dry
7/30/2012	8:57	3.6					DTW - 21.81, begin development
	9:09	4.6					Bailed dry, heavy solids
8/1/2012	10:10	4.6					DTW - 19.16, begin development
	10:24	5.6					DTW - 22.96, bailed dry
			= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Bailer

NOTES:

WELL DEVELOPMENT FIELD RECORD

JOB NAME	ROC - Salem	JOB NO.	933-6154-005
DEVELOPED BY	Jonathan Harris & Krista Cione	WELL NO.	MW12-53
STARTED DEVEL.	7/26/2012 / 8:30 (DATE / TIME)	DATE OF INSTALL.	7/24/2012
		SHEET	1 of 1
		COMPLETED DEVEL.	7/26/2012 / 16:10 (DATE / TIME)
W.L. BEFORE DEVEL.	20.12 (DEPTH) 7/26/2012 (DATE) 8:00 (TIME)	W.L. AFTER DEVEL.	20.75 (DEPTH) / 7/26/2012 (DATE) 16:10 (TIME)
WELL DEPTH: BEFORE DEVEL.	31.43	AFTER DEVEL.	NA
		WELL DIA. (In)	2
STANDING WATER COLUMN (FT.)	11.31	STANDING WELL VOLUME	1.8 gal.
SCREEN LENGTH	2'	DRILLING WATER LOSS	gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/26/2012	8:36	1.8	1.03	17.38	8.58	>1000	DTW - 20.85, heavy solids
	8:45	3.6	1.12	16.18	7.99	>1000	DTW - 20.67, heavy solids
	8:58	5.5	1.11	15.37	7.85	>1000	DTW - 20.54, heavy solids
	9:27	7.5	1.09	16.46	7.79	>1000	DTW - 20.86, heavy solids
	9:35	9.5	1.1	14.49	7.8	>1000	DTW - 20.84, heavy solids
	9:45	11.5	1.12	14.52	7.85	>1000	DTW - 20.88, heavy solids
	9:55	13.5	1.15	15.04	7.83	>1000	DTW - 21.05, heavy solids
	10:03	15.5	1.14	14.97	7.77	>1000	DTW - 20.91, heavy solids
	10:10	17.5	1.14	14.45	7.68	>1000	DTW - 20.98, heavy solids
	10:22	19.5	1.16	15.01	7.64	>1000	DTW - 20.65, heavy solids
	11:14	21.5	1.13	18.79	7.69	>1000	DTW - 20.70, heavy solids
	13:37	22	1.03	22.19	8.22	>1000	DTW - 22.45
	13:42	24	1.09	17.83	7.96	>1000	DTW - 22.61; surged well
	13:48	26	1.12	18.06	7.65	>1000	DTW - 23.28
	13:53	28	1.13	17.97	7.53	736	DTW - 23.40
	14:00	30	1.13	16.96	7.47	146	DTW - 23.37; noticeable clearer
	14:03	32	1.14	16.36	7.51	78.2	DTW - 20.49
	15:35	35	1.05	16.46	7.65	130	DTW - 22.44
	15:40	38	1.13	15.69	7.50	107	DTW - 22.50
	15:45	42	1.16	15.83	7.47	24.5	DTW - 22.70
	15:50	46	1.15	15.71	7.49	3.2	DTW - 22.71
	15:55	50	1.17	15.65	7.47	6.5	DTW - 22.74
	16:00	55	1.17	15.68	7.47	0	DTW - 22.72
		55	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Surge and pump

NOTES:

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Krista Cione
STARTED DEVEL. 7/26/2012 / 8:30
DATE TIME

W.L. BEFORE DEVEL. 21.84 7/27/2012 11:15
DEPTH DATE TIME

WELL DEPTH: BEFORE DEVEL. 42
STANDING WATER COLUMN (FT.) 20.16
SCREEN LENGTH 2'

JOB NO. 933-6154-005 WELL NO. MW12-54
DATE OF INSTALL. 7/24/2012 SHEET _1__ of __1___
COMPLETED DEVEL. /
DATE TIME

W.L. AFTER DEVEL.
DEPTH DATE TIME

AFTER DEVEL. NA WELL DIA. (In) __2____
STANDING WELL VOLUME 3.3 gal.
DRILLING WATER LOSS gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/27/2012	14:14	3.5					DTW - 39.03, light brown color
	14:21	4.5					DTW - 41.00, Pumped down to pump intake
7/28/2012	10:18	4.5					DTW - 30.03
	10:30	7.5					DTW - 41.70, purged dry
7/29/2012	9:50	7.5					DTW - 32.10
	10:03	10.5					DTW - 42.50, purged dry
7/30/2012	8:55	10.5					DTW - 32.31
	9:12	13.5					DTW - 42.40, bailed dry
7/31/2012	11:30	13.5					DTW - 32.00
	11:50	16.5					DTW - 42.60, bailed dry
8/1/2012	9:38	16.5					DTW - 32.57
	10:10	19.5					DTW - 40.81, bailed dry
		19.5	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Surge and pump, bailer

NOTES:

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Krista Cione
STARTED DEVEL. 7/26/2012 / 7:30
DATE TIME
W.L. BEFORE DEVEL. 20.70 7/26/2012 7:30
DEPTH DATE TIME
WELL DEPTH: BEFORE DEVEL. 31.09
STANDING WATER COLUMN (FT.) 10.39
SCREEN LENGTH 2'

JOB NO. 933-6154-005 WELL NO. MW12-55
DATE OF INSTALL. 7/24/2012 SHEET _1__ of __1___
COMPLETED DEVEL. / /
DATE TIME
W.L. AFTER DEVEL.
DEPTH DATE TIME
AFTER DEVEL. NA WELL DIA. (In) 2
STANDING WELL VOLUME 1.7 gal.
DRILLING WATER LOSS gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/26/2012	7:50	1.7	1.46	13.78	7.70	>1000	DTW - 24.58; begin development
	8:05	3.4	1.73	13.19	7.55	>1000	DTW - 29.76
	8:15	4.5					Bailed dry
7/27/2012	15:38	4.5					DTW - 21.20; begin development
	15:45	6	1.35	15.86	7.34	>1000	DTW - 26.71
	15:52	7.5	1.49	13.78	7.25	>1000	DTW - 29.49
	16:00	8					DTW - 31.00; bailed dry
7/28/2012	9:05	8					DTW - 26.08; begin development
	9:10	9.5	1.3	20.41	5.90	>1000	DTW - 28.30
	9:15	11	1.56	14.03	6.91	>1000	DTW - 30.97; purged dry
7/29/2012	8:50	11					DTW - 25.00; begin development
	9:20	12.5	1.49	13.85	7.42	>1000	DTW - 28.53
	9:29	14.5					DTW - 30.97; purged dry
7/30/2012	9:28	14.5					DTW - 25.00; begin development
	9:37	16.5	1.52	14.97	7.21	>1000	DTW - 28.75
	9:55	18.5					DTW - 30.97; purged dry
7/31/2012	9:55	18.5					DTW - 26.93; begin development
	10:00	20.5	1.55	16.22	7.30	>1000	DTW - 30.95; purged dry
8/1/2012	8:34	20.5					DTW - 24.74; begin development
	8:54	23.5					DTW - 30.45; bailed dry
		23.5	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Bailer

NOTES: Bottom soft at start, lots of sediments in purge water.
7/28/12 - First bailer removed is clear, the rest contain increasing solids with depth
7/30/12 - First bailer removed is clear, still heavy solids
8/1/12 - First two bailers are clear, heavy solids after

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Ben Reynolds
STARTED DEVEL. 7/26/2012 / 7:30
DATE TIME
W.L. BEFORE DEVEL. 42.44 7/15/2012 9:15
DEPTH DATE TIME
WELL DEPTH: BEFORE DEVEL. 46.7
STANDING WATER COLUMN (FT.) 4.46
SCREEN LENGTH 5'

JOB NO. 933-6154-005 WELL NO. MW12-56
DATE OF INSTALL. 7/13/2012 SHEET _1__ of __2___
COMPLETED DEVEL. /
DATE TIME
W.L. AFTER DEVEL.
DEPTH DATE TIME
AFTER DEVEL. NA WELL DIA. (In)__2____
STANDING WELL VOLUME 3 gal.
DRILLING WATER LOSS gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/15/2012	9:20	0.25	0.57	15.34	6.73	227	DTW - 42.34
	9:24	1	0.484	13.88	7.11	>1000	DTW - 43.25
	9:29	2	0.556	13.29	7.23	>1000	DTW - 45.78
	9:35	2.5					Bailed dry
7/17/2012	8:03	2.5	0.503	18.98	5.9	0.3	DTW - 40.82
	8:08	3.5	0.444	15.01	6.98	>1000	
	8:11	4.5	0.448	13.46	7.19	>1000	
	8:20	5.5					Bailed dry
7/24/2012	7:45	5.5					DTW - 28.87,well volume now ~ 3.0 gal
	9:25	8.5					Surge then pump well DTW - 38
	9:35	10.5	0.558	21.01	7.11	>1000	DTW - 44.1; purged dry
7/25/2012	9:35	10.5					DTW - 40.95; begin purging
	9:45	11.5	0.336	14.04	7.43	>1000	DTW - 44.10
	9:55	12.5	0.479	12.93	7.46	>1000	DTW - 45.60
	10:05	13.5	0.469	13.03	7.48	>1000	DTW - 46.58
7/27/2012	14:45	13.5					Resume development by bailing
	14:50	14.5	0.406	16.78	7.72	>1000	DTW - 43.57; moderate to heavy solids
	14:55	15.5	0.427	15.11	7.42	>1000	DTW - 45.49
	15:00	17.3					DTW - 46.51; dry
7/28/2012	9:01	17.3					DTW - 44.46; resume bailing
	9:21	20.3	0.604	14.96	6.32	>1000	DTW - 46.04; moderate solids; purged dry
7/29/2012	9:00	20.3					DTW - 43.83; start development
	9:10	22.3					DTW - 46.20; bailed dry
		22.3	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Bailer

NOTES: 7/25/2012 Top 2' clear, bottom feels hard

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Ben Reynolds
STARTED DEVEL. 7/26/2012 / 7:30 (DATE / TIME)
W.L. BEFORE DEVEL. 42.44 (DEPTH) 7/15/2012 (DATE) 9:15 (TIME)
WELL DEPTH: BEFORE DEVEL. 46.7
STANDING WATER COLUMN (FT.) 4.46
SCREEN LENGTH 5'

JOB NO. 933-6154-005 WELL NO. MW12-56
DATE OF INSTALL. 7/13/2012 SHEET _2__ of __2___
COMPLETED DEVEL. / (DATE / TIME)
W.L. AFTER DEVEL. (DEPTH) (DATE) (TIME)
AFTER DEVEL. NA WELL DIA. (In) __2____
STANDING WELL VOLUME 3 gal.
DRILLING WATER LOSS gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/30/2012	9:25	22.3					DTW - 43.80; begin development
	9:49	24.3					DTW - 46.40; Bailed dry
	10:15	24.3					DTW - 44.25; begin development with pump
	10:25	24.3					Pump cannot pull water, switch to bailer
	10:35	25.3					DTW - 46.13; Bailed dry
8/1/2012	8:35	25.3					DTW - 43.86; begin development
	8:54	26.3					DTW - 46.55; Bailed dry
		26.3	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Bailer & surge and pump

NOTES: Little recharge during development
7/29/12 - First bailer comes up clear
7/30/12 - Moderate solids (slightly less than previously)

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Ben Reynolds
STARTED DEVEL. 7/25/2012 / 14:30 (DATE / TIME)
W.L. BEFORE DEVEL. 21.75 (DEPTH) 7/25/2012 (DATE) 14:27 (TIME)
WELL DEPTH: BEFORE DEVEL. 41.85
STANDING WATER COLUMN (FT.) 20.10
SCREEN LENGTH 5'

JOB NO. 933-6154-005 WELL NO. MW12-58
DATE OF INSTALL. 7/13/2012 SHEET _1__ of __2___
COMPLETED DEVEL. 7/27/2012 / 12:25 (DATE / TIME)
W.L. AFTER DEVEL. 23.27 (DEPTH) 7/27/2012 (DATE) 12:40 (TIME)
AFTER DEVEL. 41.87 WELL DIA. (In) 2
STANDING WELL VOLUME 3.3 gal.
DRILLING WATER LOSS ____ gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/25/2012	14:45	3.3	0.478	20.56	7.90	>1000	DTW - 26.35
	15:02	6.6	0.439	18.06	7.81	>1000	DTW - 29.81
	15:23	9.8	0.425	18.49	7.67	>1000	DTW - 30.82
	15:42	13	0.435	18.28	7.74	>1000	DTW - 33.12
	15:59	16	0.454	17.53	7.94	>1000	DTW - 34.79
	16:15	19	0.476	18.64	7.93	>1000	DTW - 36.25
	16:40	22	0.455	17.41	7.68	>1000	DTW - 35.60; development stopped
7/26/2012	8:11	22					DTW - 21.82; resume development
	8:16	25.3	0.448	17.40	7.96	>1000	DTW - 29.01
	8:28	28.6	0.446	16.92	7.79	>1000	DTW - 29.51, notably less solids
	8:37	31.9	0.448	17.27	7.58	>1000	DTW - 30.28; surge well @ 8:51
	8:56	35.2	0.456	16.98	7.47	>1000	DTW - 29.05, slightly clearer
	9:07	38.5	0.454	16.85	7.51	>1000	DTW - 29.59
	9:22	41.8	0.455	17.9	7.55	>1000	DTW - 30.60; surge well
	9:31	45	0.458	17.13	7.64	>1000	DTW - 34.55; lower purge rate
	9:43	48.3	0.456	16.86	7.53	>1000	DTW - 34.55; surge well @ 9:52
	9:56	51.6	0.456	16.98	7.56	>1000	DTW - 34.61; noticeably less solids
	10:09	55	0.455	17.75	7.59	>1000	DTW - 34.39; surge well @ 10:02
	10:28	58.3	0.452	18.98	7.61	>1000	DTW - 35.01; surge well @ 10:16
	10:47	61.6	0.454	19.99	7.63	620	DTW - 34.65; fewer solids
	11:04	64.9	0.459	19.18	7.61	>1000	DTW - 34.23; surge well @ 10:55
	11:26	68.2	0.458	18.79	7.64	>1000	DTW - 34.75; many solids
	11:42	71.5	0.458	19.37	7.79	>1000	DTW - 36.49; many solids
		71.5	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Surge and pump

NOTES:

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Ben Reynolds
STARTED DEVEL. 7/25/2012 / 14:30 (DATE / TIME)
W.L. BEFORE DEVEL. 21.75 (DEPTH) 7/25/2012 (DATE) 14:27 (TIME)
WELL DEPTH: BEFORE DEVEL. 41.85
STANDING WATER COLUMN (FT.) 20.10
SCREEN LENGTH 5'

JOB NO. 933-6154-005 WELL NO. MW12-58
DATE OF INSTALL. 7/13/2012 SHEET 2 of 2
COMPLETED DEVEL. 7/27/2012 / 12:25 (DATE / TIME)
W.L. AFTER DEVEL. 23.27 (DEPTH) 7/27/2012 (DATE) 12:40 (TIME)
AFTER DEVEL. 41.87 WELL DIA. (In) 2
STANDING WELL VOLUME 3.3 gal.
DRILLING WATER LOSS gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/26/2012	12:03	74.8	0.464	20.74	7.58	>1000	DTW - 38.48; many solids
	12:31	78.1	0.475	20.59	7.61	>1000	DTW - 39.54; many solids
7/27/2012	8:02	78.1					DTW - 21.68; surge well, begin development
	8:15	81	0.493	18.04	7.61	326	DTW - 24.46; some solids
	8:30	84	0.485	17.80	7.44	111	DTW - 24.50
	8:44	87	0.483	16.55	7.38	631	DTW - 25.60
	8:54	90	0.483	16.59	7.38	428	DTW - 25.49
	9:10	93	0.483	16.89	7.34	129	DTW - 25.52
	9:26	96	0.483	16.92	7.33	820	DTW - 25.43; some solids
	9:40	99	0.484	16.93	7.34	166	DTW - 25.24
	9:52	102	0.483	16.98	7.35	65.5	DTW - 25.01
	10:08	105	0.480	16.86	7.38	68.8	DTW - 24.97
	10:22	108	0.475	16.95	7.34	360	DTW - 25.25
	10:38	111	0.481	17.2	7.38	365	DTW - 25.15
	10:55	114	0.483	17.72	7.41	124	DTW - 25.50
	11:10	117	0.486	17.70	7.36	88.6	DTW - 25.28
	11:23	120	0.487	17.75	7.34	48	DTW - 25.35
	11:37	123	0.487	17.85	7.35	30.3	DTW - 25.12
	11:50	126	0.485	17.79	7.36	32.7	DTW - 25.14
	11:55	129	0.484	17.86	7.33	20.1	DTW - 25.10
	12:10	132	0.481	17.90	7.32	16.2	DTW - 25.12
	12:15	135	0.487	17.94	7.36	8.8	DTW - 25.20
	12:20	138	0.486	17.88	7.35	8.5	DTW - 25.45
	12:25	141	0.485		7.34	9.4	DTW - 25.55
		141	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Surge and pump

NOTES:

WELL DEVELOPMENT FIELD RECORD

JOB NAME ROC - Salem
DEVELOPED BY Jonathan Harris & Ben Reynolds
STARTED DEVEL. 7/25/2012 / 13:20 (DATE / TIME)
W.L. BEFORE DEVEL. 17.06 (DEPTH) 7/25/2012 (DATE) 13:20 (TIME)
WELL DEPTH: BEFORE DEVEL. 36.7
STANDING WATER COLUMN (FT.) 19.64
SCREEN LENGTH 10'

JOB NO. 933-6154-005 WELL NO. MW12-59
DATE OF INSTALL. 7/13/2012 SHEET _1__ of __1___
COMPLETED DEVEL. 7/27/2012 / 12:25 (DATE / TIME)
W.L. AFTER DEVEL. 23.27 (DEPTH) 7/27/2012 (DATE) 12:40 (TIME)
AFTER DEVEL. 41.87 WELL DIA. (In)__2____
STANDING WELL VOLUME 3.2 gal.
DRILLING WATER LOSS _____ gal.

DATE/TIME		VOLUME REMOVED (GALS)	FIELD PARAMETERS SPEC COND. (ms/cm)	TEMP. (C)	pH (s.u.)	TURBIDITY (NTU)	REMARKS (DTW, Pumping Rate, etc.)
7/25/2012	13:35	3.2	0.705	19.66	7.36	>1000	
	13:43	4.25					Purged dry
7/26/2012	8:30	4.25					DTW - 18.98; DTB - 36.70
	8:52	6.2	0.73	14.3	7.55	>1000	DTW - 32.18
	9:18	9.2	0.558	17.37	7.65	>1000	DTW - 36.43
	9:52	10.7					Bailed dry
7/27/2012	8:13	10.7					DTW - 17.82; begin development
	8:21	13.7	0.685	16.4	7.74	>1000	DTW - 29.69
	8:40	16.7	0.642	16.11	7.74	>1000	DTW - 36.73; heavy solids
	8:52	17					DTW - 37.41; DTB - 38.01; bailed dry
7/28/2012	11:16	20	0.591	19.99	7.72	>1000	DTW - 32.35
	11:39	23					37.51; bailed dry
7/29/2012	10:26	25.5	0.699	16.09	7.21	>1000	DTW - 21.63
	10:37	27	0.678	15.7	7.54	>1000	DTW - 32.78
	10:45	28.5					DTW - 36.28; bailed dry
7/30/2012	10:05	28.5					DTW - 26.15; begin development
	10:19	32	0.678	14.71	7.58	>1000	DTW - 35.52
	10:31	33					DTW - 37.80; DTB - 39.15
8/1/2012	10:40	33					DTW - 31.15; begin development
	11:15	36					37.70; bailed dry
		36	= TOTAL VOLUME REMOVED (gal.)				

DEVELOPMENT METHOD Bailing

NOTES: 7/30/2012 First bailer removed is clear

APPENDIX F

DATA USEABILITY SUMMARY REPORT

DATA USABILITY SUMMARY REPORT
SOIL ANALYTICAL RESULTS
OPERABLE UNIT 2
FORMER NEASE CHEMICAL SITE
SALEM, OHIO

This report presents the findings of the data quality review performed on the analyses of environmental samples collected at Operable Unit 2 of the Former Nease Chemical Site, located in Salem, Ohio (Site). Soil samples were collected from July 9, 2012 to July 24, 2012 (Event). The chemical data for samples collected at the Site were assessed to identify quality issues which could affect the use of the data for decision making purposes.

The Event consisted of analysis of eleven (11) primary soil samples, as well as one (1) field duplicate sample one (1) matrix spike/matrix spike duplicate (MS/MSD) sample, one (1) rinse blank sample, and nine (9) trip blanks for quality control (QC) purposes. Information regarding the sample point identifications, analytical methods, QC samples, sampling dates, and contract laboratory sample delivery group (SDG) designations are summarized in Table 1.

TestAmerica Laboratories, Inc. of North Canton, Ohio (OhioVAP certification #CL0024), performed all chemical analyses. Analyses were performed following:

- Volatile organic compounds (VOCs) following USEPA SW-846[1] Method 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS) (December, 1996).

The laboratory data were evaluated following USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic Data Review (June 2008), as applicable to the above analytical method.

In general, chemical results for the samples collected at the Site were qualified on the basis of outlying precision or accuracy parameters, or on the basis of professional judgment. The following definitions provide brief explanations of the qualifiers which may have been assigned to data during the data validation process.

J The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample (due either to the quality of the data generated because certain quality control criteria were not met, or the concentration of the analyte was below the CRQL).

1 USEPA, 1996, Test methods for evaluating solid waste, physical/chemical methods (SW-846): 3rd edition, Environmental Protection Agency, National Center for Environmental Publications, Cincinnati, Ohio, accessed at URL http://www.epa.gov/epaoswer/hazwaste/test/sw846.htm

UJ The analyte was not detected at a level greater than or equal to the adjusted CRQL. However, the reported adjusted CRQL is approximate and may be inaccurate or imprecise.

R The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

The data generated as part of this Event met the QC criteria established in the respective USEPA method and the National Functional Guidelines, with the exception of the following bulleted items highlighting qualifications to specific parameters. Although these qualifications were applied to some of the samples collected at the Site, the qualifications may not have been required or applied to all samples collected. Table 2 summarizes all qualifications applied to the data, with applicable qualifier comments.

- In certain samples, all VOC results were qualified as estimated (J for detect results and UJ for non-detect results) when the sample receipt temperature was above QC criteria.
- Certain VOC results were qualified as non-detect (U) due to laboratory method blank or trip blank contamination.
- Certain VOC results were qualified as estimated (J) because a surrogate recovery was above QC criteria.
- Certain non-detect VOC results were rejected (R) when the laboratory internal standard responses were grossly below QC criteria. Review of internal standard responses is typically outside the scope of this level of validation; however, based on the deficiencies highlighted in the laboratory narrative, these results were reviewed to ensure that fully qualified data is presented.

Several sample results presented have elevated reporting limits due to the high concentration of target analytes. Dilutions do not require qualifications based on National Functional Guidelines.

Based on the data quality assessment, the analytical data for samples collected at the Site were determined to be acceptable (including estimated data) for their intended use. Generally, acceptable levels of accuracy and precision, based on laboratory control samples, matrix spike/matrix spike duplicates, field duplicate and surrogate recoveries, were achieved for the data. In addition, the data completeness (i.e. the ratio of the amount of valid data obtained to the amount expected, including estimated (**J/UJ**) data) was 98.8%.

TABLE F-1
Sample Summary and Analytical Parameters
Operable Unit 2
Former Nease Chemical Site
Columbiana and Mahoning Counties, Ohio

Lab SDG	Field ID	Matrix	Sample Date	VOCs	Field Duplicate	MS/MSD
240-13041	MW12-55(14.0-14.5)	SO	7/9/2012	x		
240-13041	TBGW_070912	TB	7/9/2012	x		
240-13041	MW12-55(22.0-22.5)	SO	7/10/2012	x		x
240-13041	MW12-60(12.5-13.0)	SO	7/10/2012	x		
240-13041	TBGW_071012	TB	7/10/2012	x		
240-13041	MW12-56(42.0-42.5)	SO	7/13/2012	x		
240-13041	RBGW_071312	RB	7/13/2012	x		
240-13041	TBGW_071312	TB	7/13/2012	x		
240-13041	MW12-59(32.0-32.5)	SO	7/16/2012	x		
240-13041	TBGW_071612	TB	7/16/2012	x		
240-13041	MW12-57(13.0-13.5)	SO	7/17/2012	x		
240-13041	TBGW-071712	TB	7/17/2012	x		
240-13041	MW12-58(37.0-37.5)	SO	7/18/2012	x		
240-13041	TBGW-071812	TB	7/18/2012	x		
240-13041	MW12-54(38.0-38.5)	SO	7/20/2012	x		
240-13041	TBGW_072012	TB	7/20/2012	x		
240-13446	MW12-52(12.5-13.0)	SO	7/23/2012	x		
240-13446	MW12-52(12.5-13.0)FD	SO	7/23/2012	x	x	
240-13446	TBGW_072312	TB	7/23/2012	x		
240-13446	MW12-52(19.0-19.5)	SO	7/24/2012	x		
240-13446	MW12-53(28.5-29.0)	SO	7/24/2012	x		
240-13446	TBGW-072412	TB	7/24/2012	x		

Notes:
MS/MSD - matrix spike/matrix spike duplicate
RB = rinse blank
SDG = sample delivery group
SO = soil
TB = trip blank
VOCs = volatile organic compounds

TABLE F-2
Data Qualifier Summary
Operable Unit 2
Former Nease Chemical Site
Columbiana and Mahoning Counties, Ohio

Lab SDG	Field ID	Analyte	New Result	Qualifier	Comments
240-13041	MW12-60(12.5-13.0)	All VOCs	-	J/UJ	Receipt temperature above QC criteria.
240-13041	MW12-59(32.0-32.5)	All VOCs	-	J/UJ	Receipt temperature above QC criteria.
240-13041	MW12-54(38.0-38.5)	1,2-Dibromo-3-Chloropropane	-	R	Internal standard response <50%.
240-13041	MW12-54(38.0-38.5)	1,3-Dichlorobenzene	-	R	Internal standard response <50%.
240-13041	MW12-54(38.0-38.5)	1,4-Dichlorobenzene	-	R	Internal standard response <50%.
240-13041	MW12-60(12.5-13.0)	1,2,4-Trichlorobenzene	-	R	Internal standard response <50%.
240-13041	MW12-60(12.5-13.0)	1,2-Dibromo-3-Chloropropane	-	R	Internal standard response <50%.
240-13041	MW12-60(12.5-13.0)	1,3-Dichlorobenzene	-	R	Internal standard response <50%.
240-13041	MW12-60(12.5-13.0)	1,4-Dichlorobenzene	-	R	Internal standard response <50%.
240-13041	MW12-60(12.5-13.0)	1,2-Dichlorobenzene	5.3	U	Method blank contamination.
240-13041	MW12-54(38.0-38.5)	1,2,4-Trichlorobenzene	4.6	U	Method blank contamination.
240-13041	MW12-55(22.0-22.5)	Carbon disulfide	4.7	U	Method blank contamination.
240-13041	MW12-60(12.5-13.0)	Carbon disulfide	5.3	U	Method blank contamination.
240-13041	MW12-58(37.0-37.5)	Acetone	18	U	Trip blank contamination.
240-13041	MW12-54(38.0-38.5)	Chlorobenzene	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	1,2-Dichloroethane	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	1,1,2,2-Tetrachloroethane	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	Tetrachloroethene	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	Trichloroethene	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	cis-1,2-Dichloroethene	-	J	Surrogate recovery above QC criteria.
240-13041	MW12-54(38.0-38.5)	1,2-Dichlorobenzene	-	J	Surrogate recovery above QC criteria.
240-13446	MW12-52(12.5-13.0)	Methylene Chloride	530	U	Trip blank contamination.

Notes:
QC = quality control
RPD = relative percent difference
SDG = sample delivery group
SO = soil
VOCs = volatile organic compounds

Qualifiers:
J = estimated result
R = rejected result
UJ = not detected, reporting limit is estimated

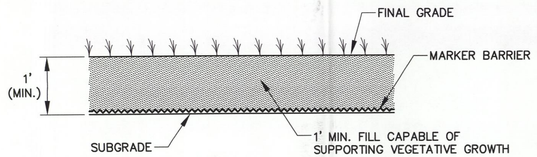
APPENDIX G

WATER LEVEL MEASUREMENTS

Well ID	Groundwater Elevation 7/3/2012 (ft AMSL)	Groundwater Elevation 7/9/2012 (ft AMSL)	Groundwater Elevation 7/16/2012 (ft AMSL)	Groundwater Elevation 7/23/2012 (ft AMSL)	Groundwater Elevation 7/31/2012 (ft AMSL)	Groundwater Elevation 8/6/2012 (ft AMSL)	Groundwater Elevation 8/13/2012 (ft AMSL)	Groundwater Elevation 8/20/2012 (ft AMSL)
AUBA	1165.48	1165.31	1165.36	1165.36	1165.42	1165.48	1165.54	1165.61
A-S	1182.86	1182.87	1182.80	1182.87	1182.87	1182.94	1182.99	1182.96
B-S	1185.27	1185.26	1185.21	1185.23			1185.16	1185.16
D-1	1178.63	1178.64	1178.55	1178.58	1178.62		1178.63	1178.62
D-11	1162.59	1162.62	1162.58	1162.61	1162.78	1162.82	1162.81	1162.87
D-13	1153.80	1153.76	1153.79	1153.76	1153.82	1153.89	1153.86	1153.82
D-14	1160.71	1161.73	1161.71	1161.82		1161.85	1161.87	
D-17	1157.80	1157.79	1157.76			1157.94		
D-2	1159.99	1159.97	1159.96	1159.93	1160.95	1159.96	1160.00	1160.11
D-3	1161.09	1161.16	1161.03		1161.20	1160.60	1161.29	
LLBA		1147.08	1147.16		1147.31		1147.27	
LVF1		1152.65	1152.50		1152.24		1152.06	
PZ-1	1173.74	1173.85	1173.66	1173.83		1173.57	1173.50	1173.82
PZ-2	1169.65	1169.59	1169.64	1169.65		1169.62	1169.62	1169.62
PZ-3S	1185.38	1185.37	1185.33	1185.31	1185.31	1185.31	1185.29	1185.29
PZ-3M	1174.73	1175.52	1175.49	1175.47	1175.53	1175.50	1175.46	1175.42
PZ-3B	1165.53	1165.88	1165.90	1165.89	1165.94	1166.01	1166.04	1166.04
PZ-4S	1179.61	1179.61	1179.56	1179.57	1179.53	1179.51	1179.50	1179.38
PZ-4M	1172.35	1172.30	1172.22	1172.13	1172.28	1172.30	1172.33	1172.39
PZ-4B	1165.62	1165.44	1165.46	1165.45	1165.54	1165.59	1165.65	1166.11
PZ-5S	1191.62	1191.54	1191.42	1192.10		1193.22	1193.18	1192.44
PZ-5M	1182.87	1182.88	1182.71	1182.85		1182.93	1183.90	1182.92
PZ-5B	1179.91	1179.91	1179.82	1179.90		1179.92	1179.88	1179.80
PZ-6B-U	1156.48	1156.49	1156.43		1156.64	1156.69	1156.74	
PZ-7	1182.69		1182.68	1182.85	1183.88	1183.91	1184.00	1183.54
S-1	1162.37	1162.37	1162.31		1162.44		1162.46	
S-13	1166.10	1166.08			1167.15	1166.86	1166.71	
S-2		1164.55			1164.49	1164.47	1164.52	
S-21		1155.11			1155.14		1155.30	
S-3	1166.14	1166.13			1166.38	1166.37	1166.49	
S-6	1186.10	1186.09		1186.05		1186.14	1186.15	
S-7	1179.39	1179.35		1179.23	1179.04	1179.23	1179.07	1178.93
S-8	1187.64	1187.66		1187.60		1187.62	1187.64	1187.75
S-9	1186.32	1186.36		1186.35	1186.29		1186.18	1186.25
EW-5	1170.86	1170.70	1170.57	1170.41		1170.14	1170.01	1169.65
NZVI-2	1156.48	1156.46	1156.39		1156.58	1156.64	1156.69	
NZVI-3					1156.90			
NZVI-4		1156.44						
NZVI-5	-16.91	-16.95	-17.00			-16.74	-16.70	
TW06-01	1185.30	1185.31	1185.25	1185.28		1185.33	1185.35	1185.35
TW06-02	1185.30	1185.32	1185.28	1185.27		1185.20	1185.18	1185.15
TW06-03	1185.78	1185.74	1185.71	1185.72		1185.76		1185.81
TW06-04	1181.62	1182.60	1182.65	1182.88	1183.82	1183.87	1183.98	1183.50
TW06-05	1184.08	1183.95	1180.04	1184.10	1185.20	1185.20	1185.18	1184.89
TW06-06	1185.82	1185.60	1185.44	1186.03		1186.83	1186.89	1186.59
TW06-08	1162.05	1161.98	1161.89	1162.00	1162.08	1162.10	1162.02	
TW06-09	1186.16	1186.14	1186.09	1186.08		1186.09	1186.12	1186.19

Well ID	Groundwater Elevation 7/27/2012 (ft. MSL)	Groundwater Elevation 7/27/2012 (ft. MSL)	Groundwater Elevation 7/31/2012 (ft. MSL)	Groundwater Elevation 7/31/2012 (ft. MSL)	Groundwater Elevation 7/31/2012 (ft. MSL)	Groundwater Elevation 7/20/2012 (ft. MSL)	Groundwater Elevation 7/20/2012 (ft. MSL)	Groundwater Elevation 8/7/2012 (ft. MSL)
TW06-10	1185.78	1185.79	1185.72	1185.78		1185.63	1185.63	1185.63
TW06-11	1186.76	1186.26	1185.99	1186.01		1185.21	1186.26	1186.31
TW06-15	1161.50	1161.93	1161.87	1162.09	1162.04	1162.05	1162.01	
TW06-16	1185.69	1185.72	1185.64	1185.69		1185.72	1185.71	1185.79
TW06-17		1184.92	1185.27	1185.33		1185.61	1185.60	1185.54
TW06-20	1184.24	1184.25	1184.12	1184.21		1184.05	1184.00	1184.05
TW06-21	1188.89	1188.88	1188.71	1188.84		1190.76	1190.85	1190.39
TW06-22	1185.20	1185.22	1185.16	1185.16		1185.07	1185.10	1184.98
TW06-23	1185.05	1185.04	1184.99	1185.00	1184.95	1184.93	1184.90	1184.85
TW06-24			1188.05			1189.99		
TW06-26	1191.50	1191.45	1191.32				1193.20	1192.65
TW06-28	1182.71	1182.68	1182.65	1182.60			1183.96	1183.50
TW06-29	1188.09	1188.07	1188.03	1188.07		1188.01	1188.00	1188.01
TW06-30	1188.07	1188.04	1188.03	1188.00		1187.96	1183.95	1187.98
TW06-31	1178.76	1178.80	1178.70	1178.69		1178.59	1178.56	1178.73
TW06-32	1186.49	1186.49	1186.43	1186.49		1186.50	1186.47	1186.52
TW06-33	1189.11	1189.11	1189.05	1190.55		1192.06	1191.75	1190.95
TW06-34	1191.65	1191.67	1191.73	1191.80		1192.41	1192.59	
TW06-35	1187.84	1187.82	1187.79	1187.77				
TW06-36	1188.35	1188.32	1188.30	1188.30		1188.25	1188.25	1188.27
TW06-37	1183.27	1183.19	1183.13				1184.56	1184.05
TW06-39	1190.90	1190.90	1190.81			1191.40	1191.58	1191.74
TW06-40	1187.95	1187.94	1187.90	1187.89		1187.88	1188.74	1187.96
TW09-41	1188.41	1188.40	1188.39	1188.39		1188.43	1188.46	1188.51
TW09-42	1188.25	1188.26	1188.23	1188.22		1188.18	1188.15	1188.15
TW09-43	1186.85	1186.81	1186.79	1186.75		1187.68	1187.94	1187.85
TW09-44	1190.36	1189.27	1190.10	1190.25		1192.85	1192.99	1192.46
TW09-45	1186.31	1186.19	1186.18	1186.06		1186.27	1186.32	1186.45
TW09-47	1178.35	1178.31	1179.30				1179.45	1179.09
TW09-48	1177.30	1177.21	1177.04				1178.03	1178.13
TW09-49	1174.57	1174.40	1174.24				1175.69	1175.85
TW12-52	ASD							
TW12-53	ASD							
TW12-54	ASD							
TW12-55	ASD							
TW12-56	ASD							
TW12-57	ASD							
TW12-58	ASD							
TW12-59	ASD							
TW12-60	ASD							

Notes:
MP = Measuring Point
Ft.-MSL = Feet above Mean Sea Level
NM = Not Measured
ASD=Awaiting Survey Data



1/5 SOIL BARRIER COVER

NOT TO SCALE

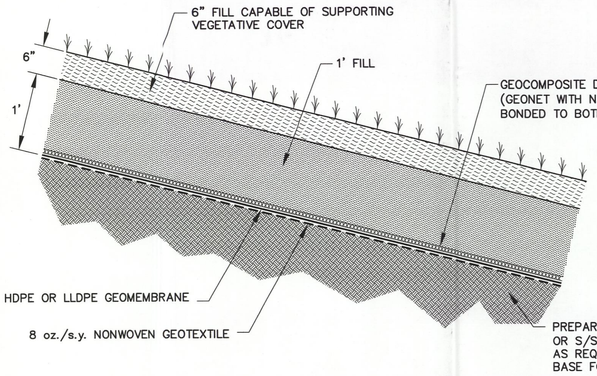
NOTES

THE SOIL BARRIER WILL BE CONSTRUCTED USING ONE OR MORE SEVERAL ALTERNATIVE DESIGNS THAT INCLUDE:

1.) ALTERNATIVE NO. 1 – REMOVAL OF THE EXISTING VEGETATION, SUBGRADE PREPARATION, MARKER BARRIER PLACEMENT, AND THE ADDITION OF A MINIMUM OF 1–FOOT OF SOIL FILL MATERIAL AND VEGETATIVE COVER.

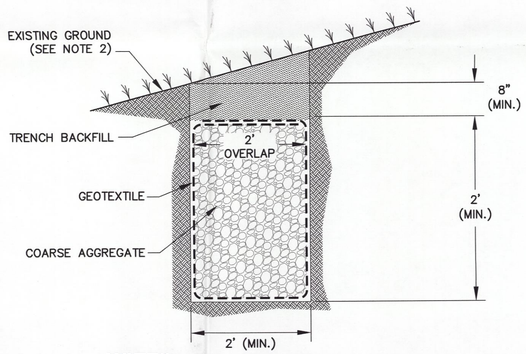
2.) ALTERNATIVE NO. 2 – REMOVAL OF THE EXISTING VEGETATION, THE EXCAVATION OF 1–FOOT OF EXISTING SOIL, SUBGRADE PREPARATION, MARKER BARRIER PLACEMENT, AND THE ADDITION OF A MINIMUM OF 1–FOOT OF SOIL FILL MATERIAL AND VEGETATIVE COVER.

3.) ALTERNATIVE NO. 3 – IN CERTAIN "HOT SPOT" AREAS, REMOVAL OF THE EXISTING VEGETATION, THE EXCAVATION OF A MINIMUM OF 1–FOOT OF EXISTING SOIL, MARKER BARRIER PLACEMENT, AND THE ADDITION OF A MINIMUM OF 1–FOOT OF SOILS FILL MATERIALS AND VEGETATIVE COVER.



2/5 LOW PERMEABILITY COVER SYSTEM

NOT TO SCALE



NOTES

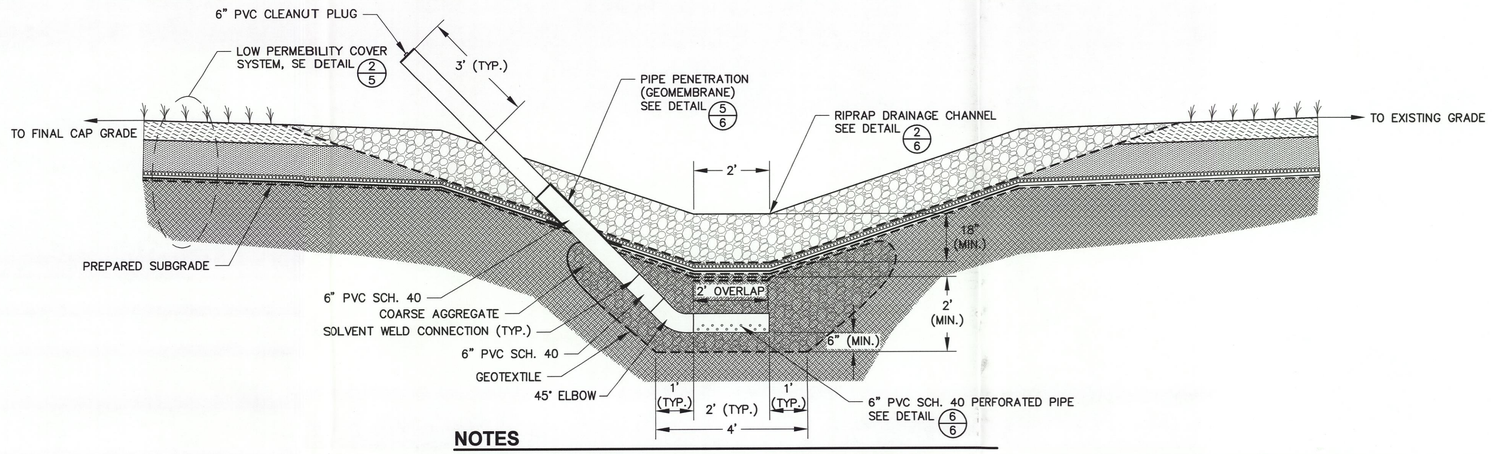
1.) DEPTH OF TRENCH VARIES.

2.) EXISTING SURFACE GRADE WILL BE MAINTAINED.

3.) EASTERN SHALLOW GROUNDWATER TRENCH SHALL HAVE A MINIMUM 1% SLOPE TOWARD THE SOUTHERNMOST RISER PIPE.

3/5 EASTERN SHALLOW GROUNDWATER TRENCH (NO DRAINAGE CHANNEL)

NOT TO SCALE



NOTES

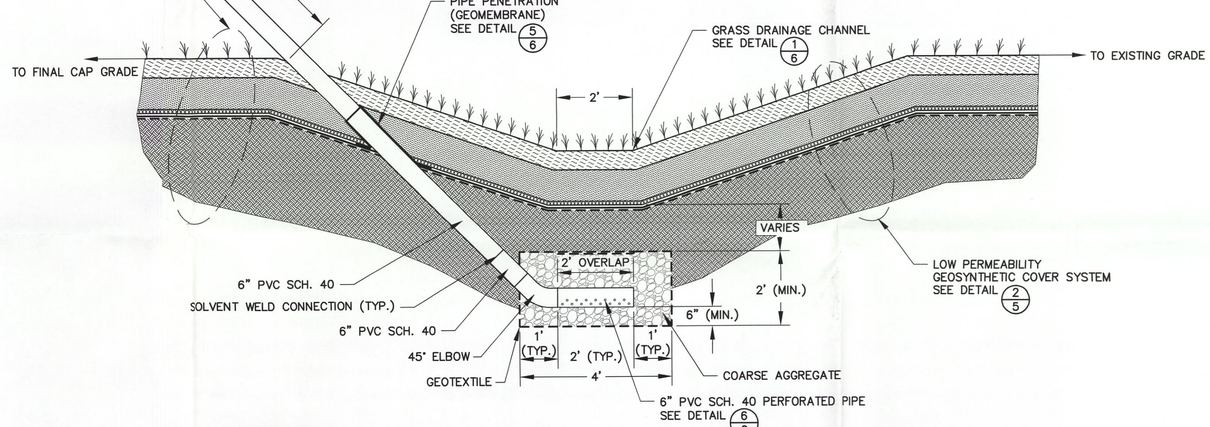
1.) DEPTH OF TRENCH VARIES.

2.) GROUNDWATER TRENCH INCORPORATES A STORMWATER CHANNEL (RIPRAP LINED) WITH A MONITORING RISER PIPE(S) AND A POTENTIAL PASSIVE OR ACTIVE TREATMENT AREA.

3.) EASTERN SHALLOW GROUNDWATER TRENCH SHALL HAVE A MINIMUM 1% SLOPE TOWARD THE NORTHERNMOST RISER PIPE.

1/4/5 EASTERN SHALLOW GROUNDWATER TRENCH (WITH RIPRAP CHANNEL)

NOT TO SCALE



NOTES

1.) DEPTH OF TRENCH VARIES.

2.) GROUNDWATER TRENCH INCORPORATES A STORMWATER CHANNEL (GLASS LINED) WITH A MONITORING RISER PIPE(S) AND A POTENTIAL PASSIVE OR ACTIVE TREATMENT AREA.

3.) EASTERN SHALLOW GROUNDWATER TRENCH SHALL HAVE A MINIMUM 1% SLOPE TOWARD THE NORTHERNMOST RISER PIPE.

1/5/5 EASTERN SHALLOW GROUNDWATER TRENCH (WITH GRASS CHANNEL)

NOT TO SCALE

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
1	09/19/12	JYS	REVISE GROUNDWATER TRENCH DETAILS	AM	JYS	CPB

PROJECT

Rutgers Organics Corporation

RÜTGERS ORGANICS CORPORATION
PRELIMINARY REMEDIAL DESIGN REPORT
SALEM, OHIO

TITLE

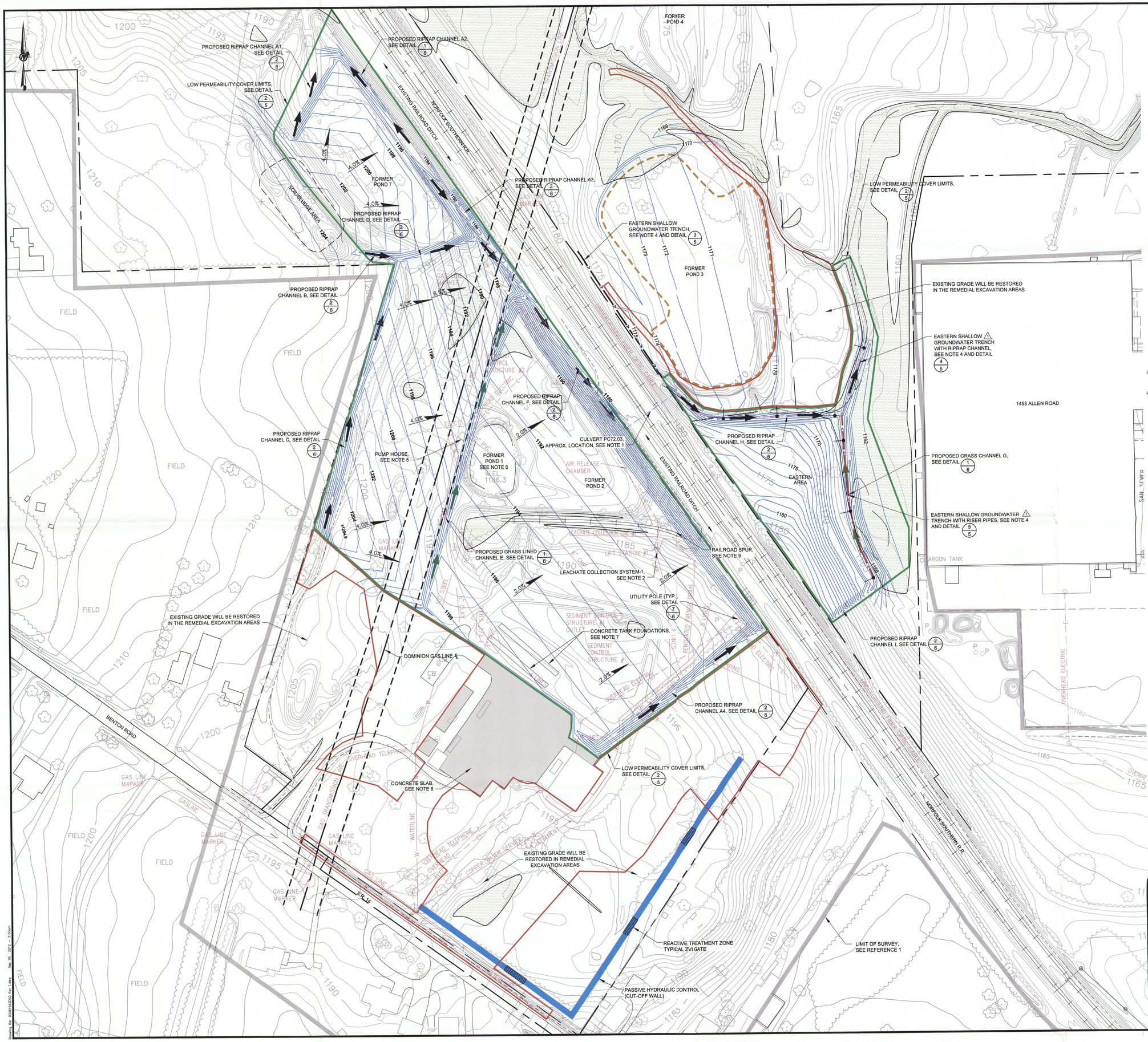
DETAILS
SHEET 1 OF 3

NJ Authorization #24GA28029100

Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		933–6154	FILE No.		9336154ZD05
DESIGN	JS	10/07/11	SCALE	AS SHOWN	REV. 1
CADD	MJS	10/07/11	DRAWING 5		
CHECK	CPB	10/07/11			
REVIEW	FTA	10/07/11			

Drawing file: 9336154ZD05 Rev 1 – Site Details 1.dwg Sep 19, 2012 – 3:05pm



NOTES

1.) EXISTING CULVERTS ARE SCHEDULED TO BE REPAIRED AND/OR MODIFIED BY OTHERS.

2.) LEACHATE COLLECTION SYSTEM MANHOLE WILL BE EXTENDED TO FINAL COVER GRADE.

3.) SEE DRAWING 2 FOR REMEDIAL SITE DESIGN LAYOUT.

4.) EASTERN SHALLOW GROUNDWATER TRENCH SHALL BE SLOPED AT 1% TOWARD THE SOUTHERNMOST RISER PIPE.

5.) PUMP HOUSE STRUCTURE SHALL BE DEMOLISHED.

6.) WATER IN POND 1 IS TO BE TREATED AND DISPOSED OF APPROPRIATELY, PRIOR TO SOIL STABILIZATION AND SOLIDIFICATION ACTIVITIES.

7.) CONCRETE TANK FOUNDATIONS ARE TO REMAIN IN PLACE UNDER THE PROPOSED LOW PERMEABILITY CAP (LOCATION SHOWN IS APPROXIMATE).

8.) CONCRETE SLABS OUTSIDE OF THE PROPOSED LIMIT OF LOW PERMEABILITY CAP AND REMEDIAL EXCAVATION AREA ARE TO REMAIN.

9.) RAILROAD SPUR IS TO BE REMOVED AND DISPOSED OFF-SITE.

REFERENCES

1.) LIMIT OF SURVEY REFERS TO THE MORE DETAILED SURVEY AREA SHOWING ONE-FOOT CONTOUR INTERVAL; THIS BASE MAP IS FROM FILE 06-3337 NEASE.DWG, ENTITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," PREPARED BY HOWELLS & BAIRD, INC., DATED 04/06/06. ALL OTHER AREAS UTILIZE A TOPOGRAPHIC BASE MAP TAKEN FROM DIGITAL FILE CREATED BY HOWELLS AND BAIRD, INC., DATED 08/14/95, DATE OF AERIAL PHOTOGRAPHY 04/06/95. EDGE OF WATER AND FENCE LINE WERE NOT INCLUDED IN THE NEW TOPO DATED 12/16/08; THESE ELEMENTS WERE ADDED FROM PRIOR SURVEY. DUE TO A BLOCKED CULVERT ON THE NORFOLK SOUTHERN RAILROAD, A TEMPORARY AREA OF STANDING WATER WAS FORMED TO THE NORTHWEST OF FORMER POND 7. THIS FORMER AREA OF STANDING WATER IS NOT SHOWN.

2.) PROPERTY LINE TAKEN FROM FILE 06-3337 NEASE.DWG, ENTITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," COMPILED FROM AERIAL PHOTOGRAPHY, DATED 04/06/06, PROVIDED BY HOWELLS & BAIRD, INC.

⚠ 3.) WETLANDS ARE FROM WETLAND MAP PREPARED BY DAVEY RESOURCE GROUP, ENTITLED "APPENDIX J - WETLANDS BOUNDARIES, ACREAGES, AND SAMPLE POINT LOCATIONS." DATA USED TO PRODUCE THE WETLAND MAP WAS COLLECTED ON OCTOBER 18, 2011.

SCALE 60 0 60 120 FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
⚠1	09/19/12	JYS	UPDATED WETLAND AND COLLECTION TRENCH LOCATIONS	AM	JYS	CPB

PROJECT
Rutgers Organics Corporation

RÜTGERS ORGANICS CORPORATION
PRELIMINARY REMEDIAL DESIGN REPORT
SALEM, OHIO

TITLE

SITE DRAINAGE AND GRADING PLAN

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.	933-6154	FILE No. 9336154Z003
DESIGN	JS	10/07/11
CADD	MJS	10/07/11
CHECK	CPB	10/07/11
REVIEW	FTA	10/07/11
SCALE	AS SHOWN	REV. 1

DRAWING 3

Drawing file: 9336154Z003 Rev 1.dwg Sep 19, 2012 - 3:03pm

LEGEND

- APPROXIMATE PROPERTY LINE
- NORFOLK SOUTHERN EASEMENT LINE
- EXISTING FENCE LINE
- RAILROAD
- DOMINION GAS LINE
- DOMINION EASEMENT LINE
- CULVERT
- DITCH
- EDGE OF WATER
- LIMIT OF PREVIOUS SOIL BARRIER COVER
- EXISTING LEACHATE COLLECTION SYSTEM (LIFT STATION)
- MIREX DISCRETE SAMPLING LOCATION
- PROPOSED LIMIT OF OU-2/OU-3 CONSOLIDATION AREA, SEE NOTE 2
- PROPOSED LIMIT OF IN-SITU STABILIZATION AND SOLIDIFICATION AREA, SEE NOTE 3
- PROPOSED REMEDIAL EXCAVATION AND SOIL BARRIER COVER (1' MIN.), SEE NOTE 1 AND DETAIL 1/5
- PROPOSED SOIL BARRIER COVER, SEE NOTE 1 AND DETAIL 1/5
- PROPOSED LOW PERMEABILITY CAP, SEE DETAIL 2/5
- ⚠1 PROPOSED EASTERN SHALLOW GROUNDWATER COLLECTION TRENCH
- PROPOSED PASSIVE CUT-OFF WALL
- ZVI TREATMENT GATE
- ⚠1 PROPOSED MKS NZVI INJECTION WELL
- ⚠1 PROPOSED MKS NZVI PROGRESS MONITORING WELL
- ⚠1 WETLANDS, SEE REFERENCE 3

NOTES

1.) AREA SHALL BE EXCAVATED AND/OR REGRADED AND BACKFILLED WITH A MINIMUM OF 1-FOOT OF SOIL BARRIER COVER IN ACCORDANCE WITH THE REQUIREMENTS OF THE TECHNICAL SPECIFICATIONS.

2.) NO SOIL FROM REMEDIAL EXCAVATIONS SHALL BE PLACED WITHIN THE DOMINION EASEMENT. SOIL SHALL BE USED WITHIN THE DOMINION EASEMENT.

3.) SLUDGE AND UNDERLYING NATIVE SOILS CONTAINED IN PONDS 1 AND 2 AND WILL BE TREATED THROUGH IN-SITU STABILIZATION AND SOLIDIFICATION.

4.) EXISTING SOIL/SLUDGE AREA SHALL BE REGRADED AND EXCAVATED. SOIL/SLUDGE SHALL BE RELOCATED AND DISPOSED IN THE PROPOSED OU-2/OU-3 CONSOLIDATION AREA.

REFERENCES

1.) LIMIT OF SURVEY REFERS TO THE MORE DETAILED SURVEY AREA SHOWING ONE-FOOT CONTOUR INTERVAL; THIS BASE MAP IS FROM FILE 06-3337 NEASE.DWG, ENTITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," PREPARED BY HOWELLS & BAIRD, INC., DATED 04/06/06. ALL OTHER AREAS UTILIZE A TOPOGRAPHIC BASE MAP TAKEN FROM DIGITAL FILE CREATED BY HOWELLS AND BAIRD, INC., DATED 06/14/95, DATE OF AERIAL PHOTOGRAPHY 04/06/95. EDGE OF WATER AND FENCE LINE WERE NOT INCLUDED IN THE NEW TOPO DATED 12/16/08; THESE ELEMENTS WERE ADDED FROM PRIOR SURVEY. DUE TO A BLOCKED CULVERT ON THE NORFOLK SOUTHERN RAILROAD, A TEMPORARY AREA OF STANDING WATER WAS FORMED TO THE NORTHWEST OF FORMER POND 7. THIS FORMER AREA OF STANDING WATER IS NOT SHOWN.

2.) PROPERTY LINE TAKEN FROM FILE 06-3337 NEASE.DWG, ENTITLED "TOPOGRAPHIC SURVEY FOR RUTGERS ORGANICS/NEASE CHEMICAL," COMPILED FROM AERIAL PHOTOGRAPHY, DATED 04/06/06, PROVIDED BY HOWELLS & BAIRD, INC.

⚠1 3.) WETLANDS ARE FROM WETLAND MAP PREPARED BY DAVEY RESOURCE GROUP, ENTITLED "APPENDIX J - WETLANDS BOUNDARIES, ACREAGES, AND SAMPLE POINT LOCATIONS." DATA USED TO PRODUCE THE WETLAND MAP WAS COLLECTED ON OCTOBER 18, 2011.

100 0 100 200
SCALE FEET

REV	DATE	DES	REVISION DESCRIPTION	CADD	CHK	RVW
⚠1	09/19/12	JYS	UPDATED WETLAND AND NZVI WELL LOCATIONS	AM	JYS	CPB

PROJECT
Rutgers Organics Corporation
RÜTGERS ORGANICS CORPORATION
PRELIMINARY REMEDIAL DESIGN REPORT
SALEM, OHIO

TITLE
REMEDIAL DESIGN SITE LAYOUT

NJ Authorization #24GA28029100
Golder Associates
Mt. Laurel, New Jersey

PROJECT No.		933-6154	FILE No.		9336154ZD02
DESIGN	JS	10/07/11	SCALE	AS SHOWN	REV. 1
CADD	MJS	10/07/11			
CHECK	CPB	10/07/11			
REVIEW	FTA	10/07/11			

DRAWING 2

Drawing file: 9336154ZD02 Rev 1 - Remedial Layout.dwg Sep 19, 2012 - 3:00pm